TYPICAL SCHOOL JOURNEYS

G. G. LEWIS

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GOLD MINERS WELCOMING NEW COLONISTS

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TYPICAL SCHOOL JOURNEYS

A Series of Open-Air Geography and Nature Studies

BY

G. G. LEWIS

MEMBER OF THE EXECUTIVE OF THE SCHOOL NATURE STUDY UNION

WITH

FOREWORD

BY THE

REV. CANON BARNETT

AND PHOTOGRAPHS BY THE AUTHOR

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Foreword

By the REV. CANON BARNETT

Poor Law Commissioners, Professors of Sociology, and Business Men all combine to urge that something more may be done in the day schools to rouse the children's interest and increase their resourcefulness. The school period is a short one in the lives of working people. Five hours a day on five days a week between the ages of five and thirteen exclusive of holidays do not give the teachers much chance. Hence it is, that alongside of this movement to modify the school curriculum, there are many suggestions for the better use of holidays and leisure time.

Reformers urge that the school buildings and parks may be more frequently used for recreation, wisely directed by grown up playfellows, that children should be prepared for their country holidays so that their eyes may be opened to enjoy the beauties and wonders of nature; that holidays of weeks may be substituted for holidays of days, and, generally, that playtime may be made a growing time for both the minds and the bodies of the children.

While such theories are being discussed, Mr. Lewis is one of the teachers who has been making experiments in what is possible. In the following pages he tells what he has done both during school and holiday time. It is a pleasure to me to commend his book. I am convinced by what I have seen of children on Hampstead Heath, or in Westminster Abbey, how much may be done in such places to impress the children's minds, and how great need there is that those who conduct the children should prepare themselves to teach. Mr. Lewis shows

how objects studied in his school can be made to live, as his children see the things of which they are told. Nature and historic buildings are the best lesson books.

But it is on school journeys that Mr. Lewis is most strong. He has taken his boys away to distant country scenes for a week or a fortnight. Together, master and pupils have drawn up maps, made excursions, met adventures and written their tales. New sources of enjoyment have been found, new capacities have been developed. There has been immediate pleasure, and who can describe the far-off results? The pupils have felt, perhaps for the first time, that there is as much satisfaction in the exercise of their minds as in their limbs; they have commenced to grow in power both to adapt themselves to circumstances and to imagine the unseen; they have —and this is no small gain—learnt how to get an enjoyable holiday.

As Chairman of the Children's Country Holiday Fund, which was able to help in meeting the expense of some such excursions, I can express the Committee's satisfaction with the result, and their hope that by the co-operation of the authorities, the teachers, and the subscribing public, this way of making holidays both helpful and joyful may be extended.

SAMUEL A. BARNETT.

Preface

THESE typical "SCHOOL JOURNEYS" are, for the most part, descriptions of open-air geography or nature lessons, which have actually been worked out by a school in North London, either in school time on Hampstead Heath, or on holiday excursions farther afield.

The natural surroundings of schools vary so greatly that it is impossible to draw up any scheme for general use; but it is hoped that the *methods* outlined will be helpful both to practical teachers and students in training.

In developing his scheme, the author has had the enthusiastic co-operation of his colleagues on the staff, Messrs. W. M. Bowen, C. J. Rose, F. Wilton, and J. W. Gofton, to whom he is indebted for several improvements which have occurred to them when giving the lessons.

He also wishes to express his thanks to Messrs. H. Longhurst and F. Wilton for permission to use the photographs bearing their names, and to Mr. J. W. Gofton for a number of the line drawings.

G. G. LEWIS.

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Typical School Journeys

CHAPTER I

Instruction in the Open Air

If briefed as educational experts to draw up a scheme of instruction for the son of a millionaire—where expense was no object—there are few teachers who would not include a certain amount of open air work in the fortunate youngster's curriculum. Even if we are not convinced Nature Study "faddists," we are theoretically agreed that much of the geography, history, drawing, and practical arithmetic can be taught better in the field than in the classroom. But stern facts in the shape of classes of sixty, and schools miles away from an open space, have prevented many of us from putting our theoretical beliefs into actual practice.

The large classes are likely to diminish in size, and there are welcome signs of Education Authorities recognizing the necessity of granting increased facilities for travel in large towns.

What are the Special Advantages of Open-Air Lessons?

Firstly. There will be an obvious physical and moral gain to the child who spends at least one half-day per week in the purer air of an open space. If during his school life we can

implant in him the open air *habit*, and give him an incentive to seek for his pleasures in the country, we shall have done something towards making a healthy and clean-minded man of him.

Secondly. With our present schoolroom atmosphere the child associates books and the desk alone with the act of learning, whereas he should be ready to learn from the World at large.

Thirdly. Granting that Observation training is essential, and that Nature provides the best material for observation, it is most important that the child's new interests should not be confined to small specimens which we can bring into, or grow in the school. To reap the full benefits of Nature Study we must take our children out into the field where they may observe natural phenomena in their own proper setting. And, what is equally important, we must encourage them to observe (shall we say) "imperially"; that is, we want them to see beauty in Clouds and Trees, Hills and Rivers, as well as in tiny tadpoles and germinating sunflower seeds.

Kinds of School Journey

School Journeys may be roughly divided into three classes.

(1) The *Open-Air Lesson*, in which a class is taken to some spot near at hand to receive instruction on some definite subject. It is simply a geography, drawing, nature study or arithmetic lesson given in the field.

(2) The *Day Excursion*, when a teacher takes the children for a ramble introducing a certain amount of instruction casually *en route*.

(3) The *Long Distance Educational Trip* to a new district for a week's or fortnight's instruction.

The Day Excursion taken on Saturday is no new thing, most teachers having spent days with their children strolling along country lanes or through the woods, combining pleasure and instruction in the most happy manner.

Long Distance Excursions were started as far back as 1896, and are now fast becoming popular with better class schools, but it was not till 1905 that open-air lessons were made possible in school time. Now, with varying restrictions according to the inspector or local authority, school journeys of all kinds, even the fortnight's educational tour, may be taken in school time.

This little book is concerned more particularly with the first two types—the long distance trips will require separate treatment.

Difficulties

There are always difficulties in the way of open-air instruction, and in some cases they appear to be insuperable under present conditions. But the value of the open-air lesson is such that the difficulties should be attacked.

(1) *There may be no "country" within easy reach of the school.* This does not apply to a large number of schools. "Country" in abundance is all around, waiting to be utilized, and even in London a good proportion of the schools are within a mile or at least a mile and a half of an open space. More than twenty schools are within twenty minutes' walk of Hampstead Heath, where most of the lessons described in this book were given. Taking a mile radius, Victoria Park reaches 36, Battersea Park 55, Regent's Park 20, Wandsworth and Clapham Commons 30, Plumstead Common and Bostal Heath 26, Greenwich Park and Blackheath 24. These are all good-sized parks, where a teacher can, as a rule, depend on finding a fairly secluded spot for teaching.

For the other town schools we cast longing eyes on the trams, not half filled at the time of day we should use them. We must persist in impressing on educational authorities the great value of open-air work, and till

they build our schools in the country, the tram ride to an open space should be regarded as a part of the "apparatus."

(2) *The Question of Staff* is probably the second difficulty in importance. Our classes average between forty and sixty in size, quite an impossible number for many open-air lessons; but on Hampstead Heath with older boys trained to the work we find no difficulty in controlling a whole class of forty. But twenty *little* boys constitute a "handful," and in a busy and crowded park they would present a very difficult problem indeed. When a school has large classes, a spare teacher would seem to be essential. The head or a pupil teacher might take one half, or look after it at school. In some quarters there is an attempt to restrict the number to twenty per teacher. This is more than enough for a visit to a museum, but when the children are well under control, and not liable to disturbance by outsiders, a teacher can give an outdoor lesson on Clouds, Trees, or Rivers to forty or fifty as well as he could in the schoolroom. The Staff question cannot be settled by any rule—the age of the children, the nature of the lesson, and the openness of the "space," must all be taken into consideration.

(3) *Can the Time be spared?* The Time Table is already overcrowded. Can another half-day be spared for open-air work? The open-air work is not a new subject, but a better way of teaching some of those already on the Time Table. Drawing, Geography, Nature Study, Arithmetic, at least can be taught as well if not better in the open air, with actual objects for study and observation. The obvious plan is to put down on the Time Table for the school journey afternoon, those subjects that can be taught in the open air. Thus our Time Table for the out-going class would read—

Drawing—Nature Study—Play—Physical Exercises—Composition. If fine these lessons are taken on Hampstead Heath.

If wet they are of course taken at school. It must not be supposed that the teacher keeps to the Time Table hours when out on the Heath.

The boys assemble at school, registers are marked, and at 2.5 they set out, reaching the Heath before 2.30. A lesson on Trees would bring in all the above subjects, and at 4 o'clock or later the teacher would start the return journey.

(4) *Paucity of Material.* The teacher may not at first be able to see where he is to find the material for a series of open-air lessons, or how he is to keep the boys fully occupied. The first tendency is to attempt lessons covering a considerable amount of ground, but the wise teacher will let the children do most of the work. A good amount of sketching should be done. Boys like it, and it is, perhaps, the best means of observation. The class is always quiet when sketching. If ideas run short, put the class on to sketching; if they become restless—let them draw; if undesirable visitors come near—sketch, till they get tired and go away. Sketching is the open-air teacher's great stand-by. Then the children should be encouraged to talk to the teacher, and tell him what they see and what they think. In this way the hour and a half will have passed very quickly, but if properly used the equivalent of three hours' classroom work will have been accomplished.

(5) *Discipline.* The discipline may cause a little anxiety during the earlier journeys. Children naturally associate the fields with play, and patience will be necessary to make them understand that they are really at school and that solid work is contemplated. To leave a troublesome

boy behind on the next journey will prove a severe punishment and have a salutary effect. It should not be necessary to *march* the boys from one spot to another, or arrange them in rows when giving a lesson. They soon learn to walk in twos and threes, and then gather quickly and quietly round the teacher for another talk.

We all rather feared the uninvited student. People do gather round, but very rarely indeed do they make other than favourable comments, and children and teacher soon get used to them. Probably the most embarrassing incident was on the occasion of Dr. Airey's visit, when an old gentleman, who looked like a retired colonel, seeing the Doctor leave his motor-car and inspect the drawing of the boys, followed him round and added his criticisms.

Scheme of Work

When regular open-air work is contemplated, a proper scheme is of course necessary. What that scheme is will depend largely on the locality available. We give our own scheme as an example of what can be done on Hampstead Heath. Schools with expert botanists or practical mathematicians would no doubt be able to add a large number of other lessons.

This scheme together with the Time Table was submitted to H.M. and the L.C.C. Inspectors, and the lessons were then given without further notification or filling up of Forms.

Latitude Desirable

No hard and fast line should be laid down as to the lesson to be taught on a particular day—so much depends on the weather and what may turn up. We regard the scheme as a sort of general guidance, but hold ourselves at liberty to

seize on any natural phenomena which may appear to be useful for teaching purposes. The actual things learnt are hardly so important as the training obtained, and it does not seriously matter if the scheme is occasionally departed from provided good educational work has been done.

Preparation and After Work

In his "School Journey" Dr. Cowham (to whose inspiring teaching the writer is much indebted) says, "I cannot too strongly impress the importance of a thorough preparation of the class before attempting the school journey."

This may be the case when arranging a big day's excursion for older students, who wish to learn as much as possible and miss nothing. It may be desirable before visiting a museum or place of historical interest. But the object of the open-air lesson is to stimulate observation rather than to impart knowledge, and previous preparation often defeats this end.

Inspectors are naturally anxious to know that the open-air lesson has not been wasted, but they should be urged to be satisfied with sketches and notes made in the field, or accounts written afterwards.

Personally we found some little difficulty in finding suitable appliances. Ordinary exercise books do not provide a firm support for writing when held in the hand, and wind and rain soon play havoc with their respectability. The note-blocks supplied by the L.C.C. are too small, and the price $4\frac{1}{2}$d. is prohibitive for each child. We now supply each boy with half a millboard on which sheets of writing and drawing paper are clipped. Forty of these are kept ready in a light dress basket for the class going out. After the lesson the boards and papers are replaced in the basket and sent back to school by a couple of boys. The next morning the papers are tied up in sets as after a brushwork lesson.

Examination

If the open-air lessons have been given satisfactorily it should be possible for the work to be tested by examination. But, and this is important—it should not be tested in the classroom. Practical Chemistry is examined in the Laboratory, and Open-Air Work should be examined in the Field. In our own school we give an examination every Spring. Boys are asked to sketch and describe a tree, to name any that the teacher has taken with them, to answer questions on the meaning of hill and valley on the spot. Marks are given and included in the Term Examination.

CHAPTER II

The Study of Trees

WHATEVER objection may be urged as to the difficulty of taking children to hills, rivers, waterfalls, or ponds for open-air lessons, few teachers can complain, even in London, of being beyond striking distance of trees. Our parks and open spaces provide a good variety of the tree specimens, but, if necessary, a course of most useful open-air lessons could be developed round one tree alone.

The Tree, as a Nature Study, possesses many peculiar advantages—

(1) Trees are so large that a good-sized class can be set to work on them in an orderly manner under the teacher's eye.

(2) Trees can be studied at all times of the year. The teacher cannot always depend on finding particular birds, flowers, or pond life, but the tree is always there—ready for a definite previously arranged lesson.

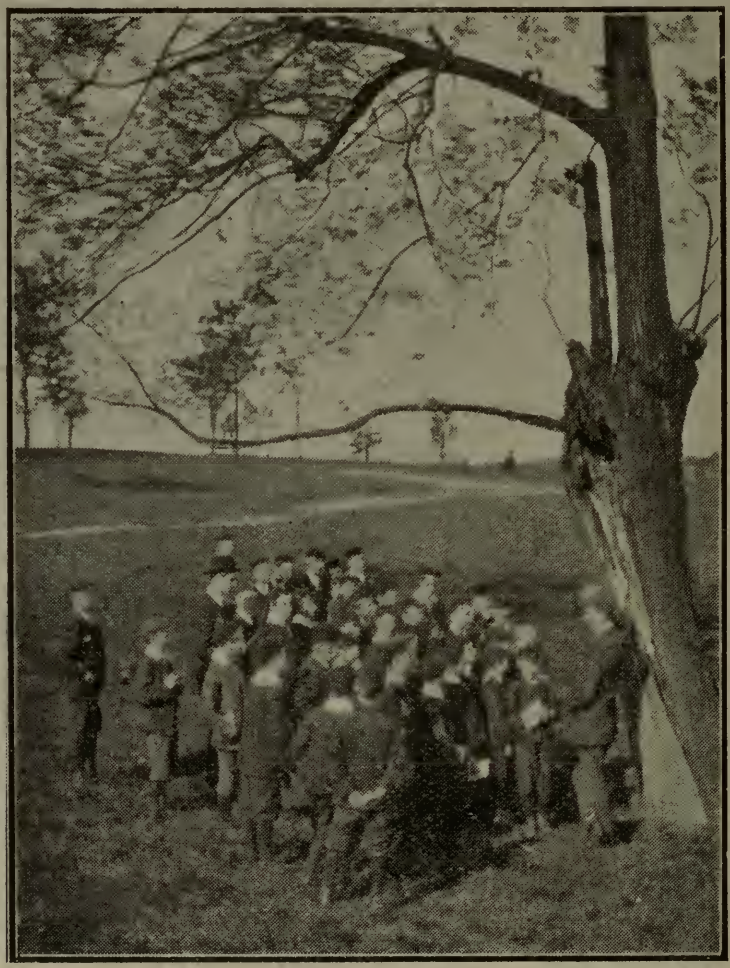
(3) Trees present a constant change of appearance—some new development is evident nearly every month.

(4) Children are naturally interested in them. The fruits of the beech, hazel, walnut, sloe, etc., are eagerly sought for eating, whilst the chestnut, oak, and sycamore supply them with objects for games and amusements.

(5) Tree specimens are so plentiful, that they can be readily obtained in quantities sufficient for after use in the classroom.

(6) The teacher who knows little of Botany or Biology can "get up" a useful knowledge of trees with greater ease than he can of almost any other branch of Nature Study.

Step's "Wayside and Woodland Trees" (6s.) will prove an admirable guide, philosopher, and friend, and by the aid of its excellent photographs and clear descriptions,



A LESSON ON THE WILLOW

the teacher will soon learn to recognize all the commoner British Trees.

Hampstead Heath and Parliament Hill, the scene of most of our open-air work, have an extremely good assortment of trees.

The order of selection is based, not on the botanical affinity of the trees, but rather on the frequency with which they are met, and the readiness with which they may be recognized.

In winter, we sketch and describe the outline and bark; buds and catkins, or flowers, receive attention in Spring; leaves and developing fruits in Summer; falling leaves and seed dispersal in Autumn. The following is the order of introduction—

Standard I.—Lombardy Poplar, Oak, Chestnut, Holly.
Standard II.—Elm, Plane, Willow and Scots' Pine.
Standard III.—Sycamore, Ash, Lime, Birch, Hawthorn.
Standard IV.—Beech, Alder, Black Poplar, Hornbeam, Larch.
Standard V.—White Poplar, Wych Elm, Hazel, Ailanthus, Walnut, Elder, Sweet Chestnut.
Standard VI. — Rowan, White Beam, True Service, Blackthorn, False Acacia.

At Work in the Field

"All this looks very pretty as a scheme," a teacher may say; "but how am I to keep a class of forty or fifty seven-year-olds occupied for the necessary hour and a half round an oak or poplar tree?"

It would, perhaps, be somewhat of a task for a clever naturalist teacher to *talk* for that length of time to little children on a couple of trees—but that is not necessary. Very little talking is required. The most valuable part of tree work lies in the *sketching*. Nothing aids observation like sketching.

A Lesson to Standard I

Let us take our Standard I straight to a Lombardy poplar. We will suppose it is a mild afternoon in March or early April, when most of the trees are bare. The children have pencils

and stiff-backed note-books or sketching-blocks. Five minutes can be devoted to a general observation of the outline of the tree—its tall, tapering trunk, its fine branches which run up almost vertically.

If we put the children to sketch it without any guidance,

LOMBARDY POPLAR
(*Contrast with Oak*)

THE OUTLINE DIAGRAM
(*As drawn by the child*)

many of them will find a difficulty over the width of the trunk and branches. Let them try—and then show them a simpler way, the outline *diagram*. One thick vertical line down the centre of the page will do for the trunk, and single lines will serve to show the shape and direction of the branches. They will soon do something. Many may be wide of the mark

—the branches will be shown in a tuft at the top, or they will emerge at an angle of 45°. These defects will be pointed out and a fresh start made.

After one or two attempts, most of the little ones will produce sketches something like a poplar tree, and having the peculiar shape impressed on their minds they will, as a rule, recognize it readily in future.

Five minutes can then be spent in spelling and writing the name underneath the sketch. The words "tall" and "slim" might also with advantage be added. It will be found that by reason of the novelty of the thing, and association with a definite object, those words stand a good chance of being remembered.

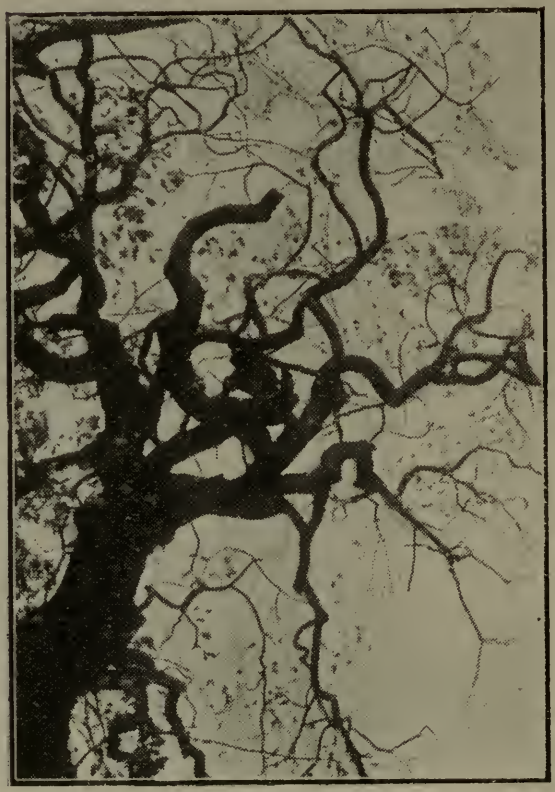
Now for the bark. Let the children draw two parallel lines down the sides of their page to represent a part of the trunk. Then let them try to fill in the markings on the portion of trunk on a level with their eye. This will not yield so satisfactory a result, but the children will thereby realize that the bark is rough and grooved, and they may learn to write down "Bark—rough," which will be a good start in trunk observation.

Taken in this way, thirty to forty minutes will fly by very rapidly, without making undue demands on the teacher's vocal powers, and, as the children will be fully occupied, little difficulty will be encountered in maintaining discipline under novel surroundings.

If possible, the oak should be taken next on the same afternoon, because of its very striking contrast to the poplar. To the untrained eye of a child, all bare trees are very much alike, but after making outline diagrams of the poplar and oak the dullest child will be compelled to see that there is a great difference between two of them at least. The careless ones will at first reproduce the perpendicular poplar branches —but after correction they will delight in following out the

numerous twists and turns of this typical British tree. " Twist " will be the key word here.

An hour and a half will be all too short to do justice to these two trees. And what have these little Standard I children done ?



OAK

(1) They have learnt to recognize two common trees.
(2) They have put in a full drawing lesson.
(3) They have increased their vocabulary and learnt to spell one or two fresh words.
(4) They have spent the time in the open air,—a striking contrast to the stuffy schoolroom.

Suppose half an hour has been " wasted " in reaching the

trees; suppose several ordinary lessons have been lost! Far more has been gained by the open-air lesson. It will be a strange child who does not begin to keep an eye on trees and watch for the first appearance of bud and leaf. A new interest has been created—one that the child will want to follow up of its own accord.

And this has been done when the trees are bare and leafless. If a lesson can be given under these conditions, there is little need to show what can be done when the buds are bursting, when the flowers and leaves are unfolded, when the fruits appear, and when the gloriously tinted leaves begin to fall.

Standard II

boys follow on with the *Elm, plane, willow, and Scots' pine.* The elm and willow are chosen bcause they are common trees and provide contrast. The small-leaved English elm is the only one dealt with, the less distinctive wych elm being left till Standard V. In the streets the well-known London plane is most frequently met with, hence its early inclusion. Naturally no attempt is made to distinguish between the numerous species of willows, but the pretty catkins in early spring compel attention, and useful observation lessons can be done with them without going into the question of pollination. The Scots' pine is included as an example of an "evergreen," and because of its very distinctive outline.

These four trees are dealt with in the way suggested in the lesson to Standard I, but, having had one year's experience, the children will more readily sketch the outline and bark, and require less anxious attention on the part of the teacher. The bark, in particular, of these four trees will prove interesting, especially in August and September, when the growth of the tree has rent the outer covering. The elm and willow show distinct cracks down the length of the trunk,

and main branches, whilst the bark of the plane peels off in great patches, leaving a green trunk behind. Standard II boys will find little difficulty in making sketches of these striking markings on the trunk, and the knowledge thus gained will be a great aid in recognizing the trees in winter, when leaves and fruits are not available. The elm buds in spring, the globular seed bunches of plane (" soldier boys ") in winter, and the willow catkins in early spring will all make useful pencil or brush studies inside the school.

SKETCHING THE BOLE OF A SCOTS' PINE

Standard III

Sycamore, ash, lime, birch, hawthorn—are all common London park trees, and have distinctive features which make them easily recognizable by young children. Even in winter the outline and bark combined of the sycamore and birch afford sufficient means of immediate indentification. The dark-looking buds and compound leaves, which only appear quite late in spring, mark out the ash; the leaves and fruit proclaim the lime; whilst no ordinary boy will fail to recognize the thorns, may blossoms, and haws of the hawthorn.

If the time at the teacher's disposal is at all limited, I would suggest leaving the lime alone till its distinctive flowers appear, and making no attempt to recognize it in winter.

The catkins of the birch would naturally be compared with those of the willow, and only the question of time need limit the lessons one could give on the way in which the seeds are produced and scattered. The winged seeds of the sycamore will afford endless amusement, and they make very pretty subjects for germination experiments.

Standard IV

Beech, alder, black poplar, hornbeam, larch. Country teachers will probably wonder why the beech is postponed till the fourth year, as its bark, buds, and " nuts " are so distinctive of this common tree. But beeches are not common on Hampstead Heath, and we have to walk some distance to reach one. Hence we wait till the boys have longer and stronger legs, and can make the journey without fatigue. There are, however, plenty of alders round the ponds, and they are easily discovered by the catkins and the seed cases. The latter persist through the winter, and are found side by side with the new female blossoms and male catkins. The ordinary Canadian variety of the black poplar is planted very extensively, not only in London parks, but also in the streets and gardens, for it grows very readily and rapidly. The lack of very distinctive features is responsible for its postponement to Standard IV.

The hornbeam will probably strike some teachers as being too rare a tree for Standard IV, but Highgate Woods and Epping Forest (places visited by us on Saturday excursions) are largely composed of them. The leaves of the hornbeam are apt to be confused with those of the hazel, wych elm, and even lime, by young observers, but the strings of seeds with

their three-lobed wings are so unlike anything else as to provide sufficient means of identification in summer and autumn. The larch supplies the children with another example of a conifer—the only one which is not "evergreen."

The Standard IV work includes sketching and description of the branches and trunk, but more attention is now devoted to the flowers and fruit, and the situation preferred by the

WHY THE WILLOW DECAYS

trees. The catkins of the alder and poplar are compared with those of the birch and willow—and afford material for lessons both in the field and in the classroom on wind-fertilization. We learn at this stage that whereas both male and female catkins are found on the same tree in the case of the birch and alder, the willows and poplars have the male on one tree and the female on another, so that in spring, they might think from the flowers that male and female willows were different trees.

Standard V

White poplar, wych elm, hazel, ailanthus, walnut, elder, sweet chestnut. With the exception of the wych elm, which boys do not, as a rule, take to very kindly, all the commoner trees have been dealt with in the first four years. It is not generally known that there is a hedge of hazels on Parliament Hill ; the catkins appear every year, and we have found nuts. The bigger boys are urged to protect these rare trees, and to keep the knowledge of their existence from the younger ones, who, in some cases, would not be able to resist the temptation to pick the pretty catkins.

The ailanthus, or Chinese sacred tree, is being planted extensively in London parks and streets, where it seems to thrive. (It is now planted alternately with the plane in Kingsway.) The ailanthus has a large compound leaf, which is often confounded with that of the ash, but a little observation will reveal a number of differences besides that of size. There is at least one accessible walnut tree—near the Highgate swimming pond.

There is no lack of material for lessons for boys in Standard V. The enemies which attack the trees may well receive special attention. Among these are caterpillars which feed on the leaves or bore into the bark ; insects which deposit their eggs in bud, leaf or flower, and produce galls.

Standards VI and VII

Rowan, whitebeam, true service, blackthorn, false acacia, laburnum, dog wood. With the addition of these trees, we have practically exhausted the ordinary trees of Hampstead Heath. As the top boys take woodwork, the knowledge of woods they gain at the Centre is drawn upon and linked up with the living trees.

Other Work with the Trees

Little boys in Standards I and II will find it a difficult enough exercise to express the tree-shape in single lines without attempting to show the thickness of branches or massing of foliage. But a teacher who is anything of an artist will be able to get much more from Standard III lads. Mr. Gofton, when master of our Standard III, succeeded in getting some of his boys to show not only the branching, but the

massing of the foliage. Greatly daring, he took a small blackboard and a light easel with him, and demonstrated on the spot how the thing should be done. Treated in this way, the work comes more under the heading of drawing, and for Nature Study purposes, it is as well to follow up the artistic sketch with the simple diagram. There are, no doubt, many teachers who would prefer to use the School Journey for drawing lessons pure and simple, and there should be no difficulty in letting the children take a sheet of drawing paper clipped to a millboard and making crayon or even water-colour sketches of the trees.

Seasonal Records

It is a very valuable exercise for a class to make sketches and notes of trees at different seasons for the purpose of comparison. For this purpose, it is well to take a twig and sketch it from month to month. In this way, the appearances of the buds, flowers, leaves, and fruit will be clearly shown. These may be kept in books by all the class, or if time does not permit of this, some of the more enthusiastic students may be told off to take one tree each—their results being pasted up month by month on a big sheet of cardboard.

Tree Survey Maps

Here, again, is a branch of tree study which will prove popular with the children. The teacher prepares a graphed map of some small portion of the district to be mapped for each journey, and the boys enter on it the position and names of all except the smallest trees. From these data it will be possible to make a large map for school reference. A good deal of practical mapping can, of course, be brought into this exercise if the teacher feels so disposed.

Tree Lessons in School

The open-air lessons on Trees will naturally suggest indoor lessons to follow them up; in fact some of the work can be done better at the desk than in the open. When catkins, leaves, and fruits are concerned, much more careful observation can be done when the children are comfortably seated, with a firm rest for the sketching paper. In the field, attention would rather be directed to the way these parts are attached to the branches, on what parts they are found, and such observations which can only be made with the whole tree before the children. The shape, margin, and veining of the leaves will be more readily dealt with in the schoolroom.

H.M.I.'S WATCHING A TREE-SKETCHING LESSON

Sketching should again occupy a large proportion of the indoor lesson, especially with little boys, supplemented by about ten minutes' conversation, and then a few words or simple sentences to be copied from the blackboard.

The Brushwork will naturally be co-ordinated with the study of trees. With good Nature Study lessons, freehand drawing need not be specially provided for.

A useful seasonal record may be provided by mounting the best sketch each month on a card, and children might well be encouraged to keep such a record themselves.

The acorns provide valuable material for germination experiments. Placed in damp sawdust or moss in autumn they will show a fair amount of growth before the next summer. Acorn glasses (similar to hyacinth glasses) are sometimes used for this purpose. Plants produced in this way should be compared with bursting acorns, which may be obtained in numbers round the base of almost any oak tree.

CHAPTER III

The Lake in the Park

A Simple Geography Lesson for Standards I and II

After Trees, the Lake is the commonest *big* object in the public parks available for teaching, for the majority of open spaces enclose one or more pieces of water within their borders. If absolutely artificial, they are not likely to present many points of interest, but where a stream has been dammed up, some approach to natural conditions may be expected.

At first, the teacher may wonder how a whole geography lesson can be spent at a pond. "My boys, here you see a piece of water with land all round it. That is a lake."

What more can be done ?

The sharp boys may grasp once and for all time the idea of a lake, from the sight of an actual specimen, but we all have some slow boys who will not, and there can be no harm in driving the matter well home while we have the opportunity. Suppose, for a start, we walk all round it, and, if we have time, divide the class into two halves and let them walk round the lake in opposite directions. This will help to impress the idea that one can walk all round a lake—that land surrounds it on all sides.

Sketching the Lake

An attempt may now be made to get some sort of a sketch of the lake. Let the children try by themselves first. The result will be instructive to the teacher, and will reveal some of the difficulties experienced by the young mind in understanding a map.

This exercise is best tried with a small pond or lake first ; the Serpentine, in Hyde Park, would obviously be beyond the powers of a seven-year-old. Ask the children to go up in a balloon. Make it as real as possible—" Here is our balloon —step in. Now we are off—up—up, till we are just over the

HIGHGATE CAPE AND BAY

lake. Pencils out and make the sketch." The sketching of little ponds or islands appeals with more directness to the young mind than making plans of the schoolroom and streets It forms a most valuable introduction to map reading.

Capes and Bays

Most of our park lakes are extremely artificial, the sides having a more or less smooth and regular outline. But some,

notably those in Finsbury Park, Regents Park, Victoria Park, Wandsworth Park, Battersea Park, and Dulwich Park, possess an indented coast-line, presenting some sort of an approach to cape and bay. Here we would ask for sketches of the part of the lake under observation, and then tell the children that the piece of land sticking out into the water is a cape, while the water which is partly enclosed by it is called a bay.

An ideal method of tackling the subject would be to send some boys in a boat with a boatman to cruise round the shores on a voyage of discovery, while the teacher followed round with the rest on land. The capes and bays should be named after the discoverers.

It is a pity that some attempt is not made to give artificial lakes a more natural appearance ; they would look prettier and would help the teacher greatly. There is a beautiful little lake in the new part of Peckham Rye Park, with capes and bay, and the little river running out of its lower end has been given an apparently natural course. It bends and winds, and does not flow over a concrete bed. There is also a waterfall—a broad, straight arrangement made of old bricks. Nearly all the L.C.C. lake scenery is spoilt because of this persistent use of clinker. A man who knew ever so little of physiography would have been able to plan a little cascade over actual rocks. As it stands, the waterfall is neither pretty nor instructive.

The Island. A Place of Safety

The Highgate and Hampstead ponds which our boys investigate are devoid of islands ; we have to draw on imagination and let the bathing stage do duty for island, isthmus, and peninsula. But a good number of London lakes have very pretty little islands. Where boats are available, we

would again take some of the best boys for a voyage of discovery, and demonstrate the existence of an island in the same way that explorers have to do on a larger scale.

An attempt may well be made to let the children see the advantage of a country being an island instead of part of the mainland. Suppose the boys in the boat landed on the island, could the rest of the boys fight them ? Suppose they got in another boat, could they land if the other boys stopped them ? Where do the ducks go when they want to get away from bad boys ? The sharper boys will soon see that if they were defending the island, they could do it best by meeting their enemy in boats and having the fight on water. Hence the need for a big navy to an island country like England.

How Lakes are Made

We cannot always show the children how our London lakes obtain their water or how they were made ; but when possible it is advisable to do so. The Hampstead and Highgate ponds, for instance, are fed by two branches of the River Fleet, which can be seen entering at the upper end of the top ponds in each case. The lower end is seen to consist of a long solid wall. How did it get there ? Does it look natural ? No, it has been evidently built by men. Why ? To dam up the river and to make a reservoir from which the people could get their water supply. Rather advanced work, perhaps, for Standards I and II, but quite within the range of Standard III children, who may be led to see how Liverpool and Birmingham have gone to Wales for water, and how London may have to go there, too.

In many parts of the country the " lake " will be a millpond, where the water has been dammed up for power purposes. It will often be possible to see how the stream brings down a load of sand and mud, and depositing it in the lake, tends to

fill up the hollow and make the upper end shallow, while the water is clean and clear as it passes out at the lower end.

The Lake Magnified into a "Sea"

Where the shores of the lake are natural, we may have miniature sea cliffs and chines. A portion of the Hampstead bathing pond is still without an L.C.C. sea-wall, and has a most instructive steep sea-cliff for a short distance on the

THE SCHOOL LAKE, MONTPELIER HOUSE OPEN-AIR SCHOOL

N.W. shore. After rain, small streams pour down from the Heath as rushing torrents, and these have worn out deep-cut chines and ravines just as the larger streams do in the Isle of Wight. Further, these streams carry down little loads of mud, and spread it out delta fashion in the tideless ocean below.

Practically all the ponds are now either enclosed for shrubs, or walled for walking.

To the ordinary visitor this portion of the margin of the lake may look untidy, and in wet weather we must confess

it is distinctly dirty and slippery. But to the teacher who has imagination, it presents one of the most charming and valuable little bits of coast for observation and Nature Study. We trust the day is far distant when the L.C.C. will feel it necessary to take it from us.

The School Lake

In some cases, it might be possible to construct a small lake for teaching purposes in the playground. Such a lake was made by Mr. Robson at the Montpelier House Open-Air School. A photograph is here shown (page 33). The Birley House school had a river running down one of the paths, its source being a tap. In new schools, at any rate, it should be possible to provide a small river-course and lake along one side of the playground.

CHAPTER IV

The Stream

The River may be regarded as the central geographical unit, for by it the land has been sculptured into its present configuration. At its mouth ships arrive laden with produce from other countries, by its banks towns most frequently arise, and along its valley the great railways thread their way. As a basis for geography teaching it is all important. Apart from this, few examples of Nature's handiwork surpass the river in supplying valuable material for observation and study. Not only is it available in summer when plant and animal life are most prolific, but it can be studied as well, if not better, in winter when Nature lies dormant. Small students of six and seven can be taken to it for simple little geography lessons, whilst it presents problems hard enough for boys and girls at the top of the school to solve.

The river has a further attraction to the teacher who contemplates conducting a school journey. He may know little of biology, botany, or geology, and may hesitate to embark on observation lessons dealing with plants and animals. But every teacher knows his geography and need have no fear of tackling the river. We propose to describe more particularly a lesson we are able to give to our own boys on Hampstead Heath. This will serve to show that the work is not merely theoretical but practicable. At the same time, the points dealt with will be capable of application to any small stream in the country, and very few schools indeed are without a stream in their immediate vicinity. Those in the neighbourhood of hills are especially fortunate, as they are sure to have

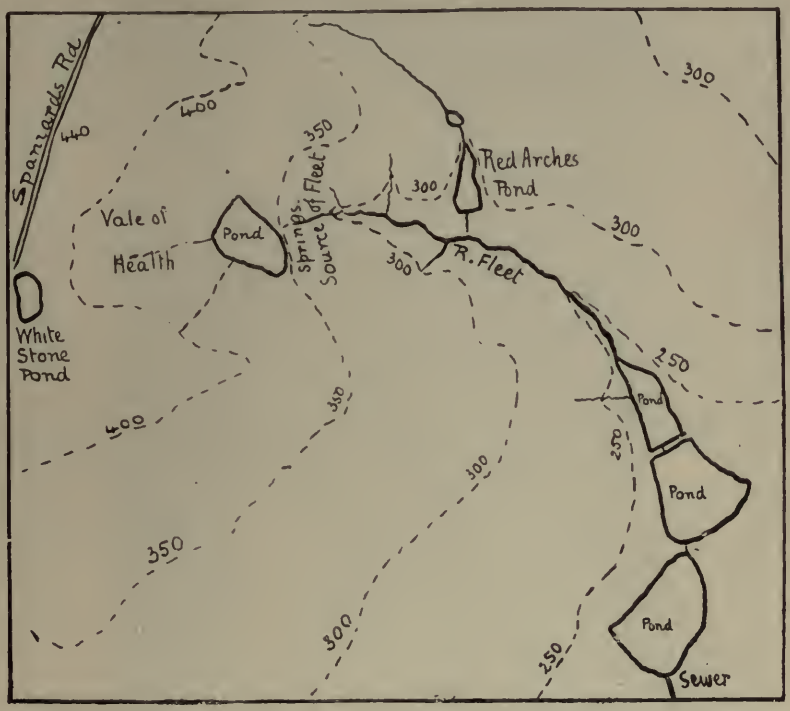
the source and early course of streams at their disposal. With these it is possible to study river work and the making of valleys much more effectively than when the stream has assumed larger proportions. On Hampstead Heath we have such a stream in the Fleet, which rises in the Vale of Health as a chalybeate spring, and flows for half a mile or so before it broadens out into the reservoirs which constitute the

THE STREAM CAN BE STUDIED IN WINTER

Hampstead ponds. At one time it meandered through north London as the Fleet Ditch, giving its name to Fleet Road and Fleet Street. On leaving the ponds it *now* enters a sewer and in that way completes its journey to Blackfriars Bridge. But the half mile from source to ponds is rich in teaching illustrations; its valley is well marked and several tiny tributaries join it.

In tackling a stream one is at first inclined to take the

children to the source and work *down* it. We think, however, it is better to start lower down the river and follow it up, where possible, to its source. This is man's usual way of exploring a river, starting from the sea ; and the most striking feature, to a child, the fact of the stream rising in the spring, is presented last of all. When revising, it may be well to go



THE R. FLEET AND ITS PONDS ON HAMPSTEAD HEATH

down stream, but we are convinced of the advisability of following it *up* on the first open-air lesson.

Let us make a start with the little Standard I boys, for if we can teach *them* in the open air, older children will present no difficulty. We take them to the stream and allow them to place little boats on it. This of course is fine fun and they will be reluctant to leave it for more serious work. " Now watch.

Which way are the boats going ?" Children point down the stream. " Why ? " Some will say, " The wind is blowing it " ; many will vouchsafe no answer. Start the boats again and ask the boys to look very carefully, and they will be able to see that the water is running along, and they may be led to the definition of a river—a stream of running water.

Why does it run ?

Place a drop or two of water on a boy's millboard and ask him to make the drops run. They will then see that water runs when it is on a slope, and will then understand that the river is running because the land slopes.

The Bed and Banks

At first we could not get these lively youngsters to listen carefully to a dissertation on Bed and Banks, so we had resource to the following imaginary conversation.

" I say, River ! "

" Yes, teacher."

" What is this ? " (prodding the muddy bottom with a stick).

" Leave my bed alone, you are tickling me."

" Leave your *what* alone ? "

" My bed."

" What is your bed made of ? "

" Look and see."

(Boys look down carefully and give answers—mud, stones, pebbles, sand.)

" But is your bed made of mud ? "

" Of course it is, what else could it be made of ? "

(To boys) " Tell the river what *your* beds are made of ? "

" Well, I prefer mud and sand, or else rock."

" Does your mother make your bed ? "

" I make it myself ; I'm always making it."

" Where do you get the mud from ? "

" Don't ask silly questions—find out."

(Sharp boys will soon " find out.")

" I suppose, then, we are standing at your bedside ?

" Oh no, you are standing on my *banks.* I've got two banks, a right bank and a left bank."

THE RIVER FLEET

" Which is your right bank ? "

" Tell your boys to look in the same direction that I am running. (Boys do this without further order.) Now tell them to put out their right hands. Yes, that's it. They are now pointing to my right bank. Now tell them to put out their left hands and point to my left bank. I say, teacher, there is a little boy on the left bank not attending to you."

The boys will listen intently to an imaginary conversation of this sort, and attention having been gained they may be asked to make a little diagram showing right and left banks—an arrow in the river indicating the direction of the current.

The River Winds in and out

We now walk up stream, half of the class on each bank.

RIGHT AND LEFT BANKS OF THE STREAM

Children are asked to notice whether the river is straight. No, it is "curly," it winds in and out.

"Why don't you go straight, Mr. River?"

"How can I, with a lot of things in my way?"

This again may be illustrated by more drops of water on a millboard with a little clay obstacle in its path.

Once again the children should be asked to make a sketch of some portion of the course. It may not be accurate, but if it shows bends this will be sufficient.

A Tributary or Feeder

A little farther up we discover a tributary. This is an exciting moment, for we let the two streams quarrel as to which is the chief one.

"I can run quicker than you can," cries the tributary in a high voice.

SKETCHING THE COURSE OF THE RIVER FLEET

"But I am bigger and broader and longer," replies the main stream in a deep voice. "You are only a feeder."

Ask the boys to decide which is the chief one, the big, broad, long, slow stream, or the swift short one.

Other feeders will be eagerly looked for on the right and left banks; boys may be asked to keep count of the tributaries which come in on their respective sides.

The Source

The stream gets smaller and smaller, and at last comes to an "end," as one boy says. "This is not the end of me, only the beginning—you are now at my source—where I am born."

Source is a new word and should be written down. The Fleet oozes out of the ground in a sort of bog, but the boys may be told that many rivers start with a spring out of the hillside, like the River Thames.

The ground covered so far will make a good hour and a half lesson. The next visit may well start at the source, where the boys will be asked to look down its course, and have their attention directed to

The Valley

Following the stream down, the valley should be the main theme. Always we are at the bottom of a hollow—hill slopes on each side. Each little tributary has its own small valley, and they come to the conclusion that every river runs at the bottom of a hollow or valley. The previous lesson will be revised, and the boys eventually come to the "mouth" which opens into the sea, in our case the Hampstead Pond. Amongst other points to which attention will be specially directed are the following—

(1) The river grows broader and deeper, but does not run so swiftly as it nears the sea.
(2) It is bigger after a feeder runs into it.
(3) It carries down mud and sand to the sea and so helps to fill it up.
(4) Tested with paper boats, it runs quicker at one place than another.
(5) The boats sail more readily in the deeper water near the mouth.

Work with other Standards

Standards II and III may with advantage be set to measure first the width and then the depth of the banks of the stream at different points. It is not always easy to decide the width of the stream in Summer, as it often shrinks to very small

MEASURING THE WIDTH OF THE STREAM

proportions. The banks, however, are fairly well defined, as a rule, and it is well to measure from bank to bank. The boys will find that though the river gradually increases in width, it does not do so uniformly. Here, for instance, are readings from a boy's note-book in inches :—10, 16, 20—(tributary enters) 53, 38, 32, 72.

To get the depth of the channel, a rod is placed across from bank to bank, and a weighted tape measure suspended from it. They should be encouraged to observe the connection of speed with depth of channel, swift stretches producing deep gorges.

Watershed and River Basin make a capital lesson requiring much thought on the part of teacher and children. It is really hard enough for Standard III. The ridge connecting Parliament Hill with the Express Dairy Farm provides an excellent example of watershed, the Highgate and Hampstead branches of the Fleet being on either side. Standard IV boys, who have had previous open-air lessons, will be in a position to make a rough map of the River course, investigate the rocks of the drainage area, and acquire the rudiments of scenery sculpture as performed by the river.

The upper standards may work out the contour lines, make a model from ordnance maps, and do a little elementary chemical analysis of the water.

CHAPTER V

The River

(A Whole Day Journey)

The small stream with source, miniature tributaries and valleys provides the best material for little ones in the first three standards. Older scholars, too, may learn much from such a stream, but a large brook or small river will yield more experiments and a wider grasp of river action. The Thames at London is far too big, but the Mole from Leatherhead to Box Hill is just about the right size. The Mole is too far away to be compassed in an afternoon's lesson, and we will therefore take this as a sample of what can be done in a whole day excursion. H.M. Inspectors are generally prepared to allow a class to go off for a whole day in school time when a properly set out programme is submitted to them.

In our case, we tackled the Mole in the morning and went on to Betchworth for the Chalk Quarry (described in Chapter XII) in the afternoon.

Railway Fares and Meals

The railways grant fare and a quarter for the return journey if the equivalent of 10 adult fares be taken. It is better, however, to raise the number to 50 or 60—and take one or two adults to make 30 adult fares, when single fare for the return journey is allowed and the age limit extended from 12 to 14.

The boys take a substantial lunch with them, and as they

naturally wish to be in the country as long as possible it is worth while trying to secure another 6d. per head and supply them with tea. The return can then be made late in the evening.

Previous Preparation

For the ordinary open-air observation lesson, we do not recommend previous preparation for reasons already stated, but when children are taken away for a day to a distant place only available perhaps once in the year, the teacher will want to make the most of his opportunities educationally. An attempt should be made to give the children a rough idea of the topography of the district to be visited, the nature of the rocks, the course of the river concerned, and perhaps some idea of the experiments to be tried or lessons learnt. This may not be the best method theoretically, but it is desirable as a matter of expediency.

Maps and Notes

A sheet containing a few notes and several maps was supplied to each boy. The notes gave—

(1) A complete time table of the day, including train times.

(2) What to take—lunch, pencil, and note-book, corks, hammer, and satchel.

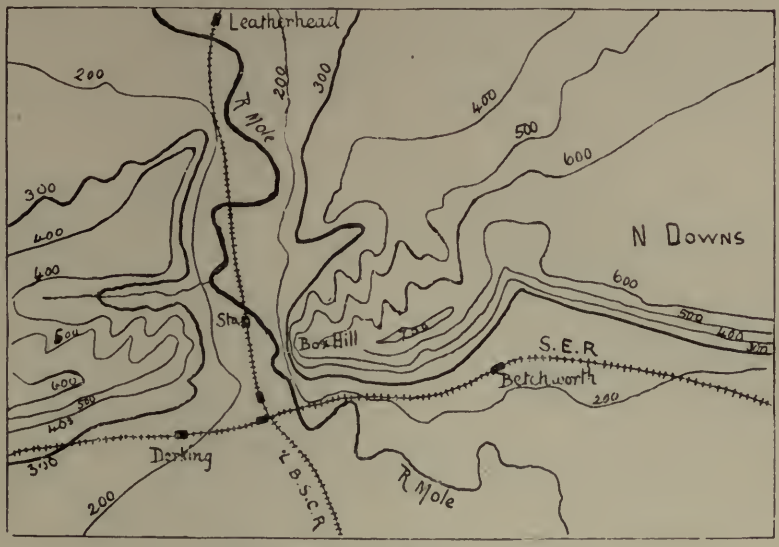
(3) A concise summary of the object of the trip and the work to be undertaken.

(4) Points of interest to be observed on the railway journey.

The following maps were prepared from Ordnance Survey maps—

(1) A map of the railway journey, showing the stations passed, the rivers crossed, hills to be seen, and the rocks passed over. The boys were asked to keep a special eye on the shapes

of hills, kind of scenery produced, and flora supported by the different rocks and also the slope of the railway cuttings.



MAP OF THE MOLE GORGE

(2) A one inch contour map of the Mole Gorge with the 300 line specially thickened. This is a most useful device when it is desired to bring out some particular feature of a district. Had we wished to bring out the long line of Chalk Downs, we should have thickened the 500 or 600 line, but in this particular lesson we wished to emphasize the narrow valley which the Mole has cut through the Downs. The 200 line would have answered our purpose, but we also wished to show two tributary valleys, and so chose the 300.

(3) A six inch map of Box Hill, included chiefly to show the outline of Box Hill, but also to remind the lads that maps are drawn to larger or smaller scales at will.

We propose to indicate the work done at the Mole in the form of a Teacher's Notes of Lesson, which may give the young teacher some idea as to how notes may be set out for an open-air lesson.

Notes of Open-Air Lesson on the River Mole to boys of Standards V, VI, and VII

Time 1½ *hours*

Experiments and Observations	*Leading Questions*
1. Take Boys to Burford Bridge. Observe direction in which it flows.	Which way lies the sea ? Which are right and left Banks ?
2. Let a number of boys drop corks simultaneously into the stream. Observe their rate of progress.	Which corks move fastest ? Why does the middle of the stream flow faster than the sides ?
3. Take boys to river bank, placing them at distances of twelve yards apart. Throw stick or cork into middle of stream and note time taken to pass each boy.	How long did it take the stick to travel eighty-four yards ? How long to travel one mile ? What is the speed per hour ? Why did the speeds vary ?
4. Take boys to a sharp bend. Observe steepness of bank on outside compared with inside.	Why is the outer one steep ? Which bank gets worn away ? What happens on the other side? What is the effect on the course of the river ?
5. What a river brings down. Observe sand and pebbles in bed of stream and on the banks. Take a bottle of water and allow to settle.	Where do the pebbles, sand, and mud come from ? Might there be anything in the water we cannot see ? How could we find out ?
6. The bed of the Mole. Observe carefully the bed.	What is it made of ? What would be the effect of water passing over chalk ? Why is it called the *Mole ?* What would be the best bed for a river if no water is to be lost ?
7. The work of the River. Take boys half way up Box Hill. Observe gullies on the way.	What made the gully ? When has a stream most force ? What is a river always doing ? What will happen as the streams continue to work down the gully ?
8. Valleys. Take boys to summit of Box Hill. Observe : (*a*) Small valleys. (*b*) The Mole Gorge.	How have the little valleys been formed ? How has the big valley been formed ? Why is its side steeper than that of the Fleet on Hampstead Heath ?

Notes on the Various Sections of the Lesson

Nos. 1 and 2. Revision of previous work on Hampstead Heath.

No. 3. Pairs of boys were placed at intervals of 12 yards along the bank, the teacher occupying the starting place. He threw a stick into mid-stream and then in a loud voice

TIMING THE CORKS AS THEY FLOAT DOWN THE STREAM

called out the seconds. As it passed each pair of boys they put down the number of seconds being called out at that moment.

One of the records came out as follows—

Teacher at start.	0 seconds.
No. 1 at 12 yards	8 ,,
No. 2 at 24 ,,	17 ,,
No. 3 at 36 ,,	25 ,,

No. 4 at	48	yards	30 seconds.
No. 5 at	60	,,	41 ,,
No. 6 at	72	,,	50 ,,
No. 7 at	84	,,	60 ,,

Several records were taken which varied somewhat owing to the position of the cork in the stream and also to error in correct estimate of moment of passing, but we calculated the average speed of mid-stream at about three miles per hour.

RIVER BEND IN THE USK SHOWING STEEP CLIFF ON OUTSIDE OF BEND, DEPOSIT OF PEBBLES ON INSIDE

No. 4. The boys were much interested in observing how the corks were nearly all swept round the outside of the curve when they reached a bend. They readily saw that the swift stream would wear away the bank and make a steep cliff, while the slow moving water on the inside bank would drop some of its load of sand and pebbles and tend to make a sand

bank. They were not quite so quick at grasping the effect this would have in making the bend bigger, and this was worked out by sketches on the B.B. after the return to schools.

No. 5. The material brought down by the Mole proved a very interesting theme, producing an interesting crop of questions. The river had been in flood and the path was strewn with sand and other debris left by the flood as it subsided.

" How high did it rise ? " asked a boy.

" Look around you and see," was the reply.

The boys dispersed and examined the banks for sand and pebbles. Eventually a visitor suggested an examination of the overhanging trees on the banks, and the lads soon recognized a dirty " water mark " at high flood level.

No, 6. The Mole passes over chalk for some miles after rounding Box Hill, and though very rarely, if ever, does all its water soak through, yet the lads saw on their journey that the stream lower down was frequently very small, though nearer the sea. Later in the day they noticed that one of the side valleys was devoid of a stream.

No. 7. Boys should never be asked to believe the mere statement that a large valley like the Mole Gorge was cut by the small river running at the bottom. The small gullies were evidently torn out by running water, and they soon saw that continued action would make a larger cut into the hill-side, so that a small valley would appear increasing in length and depth, in course of time.

No. 8. On the opposite side of the valley could be seen a larger gully which more nearly approached the dignity of a valley. Farther along a larger tributary valley provided the connecting link with the big gorge which lay at their feet, and at last the boys realized that before the Mole set to work it would have been possible to reach the other side without making a descent into any valley.

The Chemistry and Arithmetic of the River

Schools with large upper standards and a well equipped laboratory, could pursue the subject further by estimating the quantity of solid material present in solution and suspension in a gallon of water. Knowing the speed and average width and depth of the river, it is possible to form an approximate estimate of the volume of water passing in the course of a year, and then the weight of material removed from the land and carried out to sea.

CHAPTER VI

A Waterfall

NOT every school has a waterfall within easy reach, but those who have are indeed fortunate. Waterfalls provide such interesting material for open-air observation lessons that it

Photo by *H. Longhurst*

OUR LESSON ON A WATERFALL

is worth while to take some trouble in order to visit one with the class.

Here, in London, a natural waterfall of any size is miles away. The artificial falls seen tumbling over masses of broken masonry in some of our London parks are worse than useless —they convey absolutely wrong impressions. South Wales is probably the nearest spot which affords falls of any teaching value. The examples used to illustrate this particular journey are of no great size, but they are useful to the teacher who wishes to use them for open-air observation lessons.

One hundred and fifty miles away, in Breconshire, the Usk flows at the bottom of a broad and deep valley it has cut for itself through marls, sandstones, and limestones. On either side smaller tributaries descend from the mountains, leaving deep gashes in their slopes as evidences of the excavating power of running water. Those on the right bank have the greater interest, because they have had to wear out their path over very hard rocks with some softer strata sandwiched between them. One of these—the Clydach, has succeeded in cutting its valley right back to the Welsh mining

THE CLYDACH AND ITS GORGE

town of Brynmawr, and has augmented its own natural water supply by tapping and annexing the upper course of a stream which used to flow down the other side of the watershed.

Hence, the Clydach has been able to make a braver show of scenery-carving than some of its fellows, and in its downward course over Coal Shales, Millstone Grit, Mountain Limestone, and Old Red Sandstone presents us with a large variety of extremely pretty and intensely interesting waterfalls.

Let us start at the top a few hundred yards below Brynmawr. The photograph shows the stream, rushing along

at the foot of a deep gorge at a height of a thousand feet above sea level. The two openings seen in the top strata are workings driven horizontally into the coal measures which crop out on the side of the valley and so can be quarried. The attention of the class is directed to the enormous eroding power which a rapid stream possesses.

A little farther down the valley we come upon the extremely interesting little fall, seen on page 56. It is a young Niagara, showing not only the way in which a fall is produced, but also presenting a good example of a gorge in the making.

Leaving the disused tramway, which crosses the middle of the picture, the boys scramble along the side of the stream to the fall beyond.

Their attention will probably be attracted by the curious pebbly rock, the Millstone Grit, which forms the path. It contains great pebbles which, when struck with the hammer, prove to be extremely hard. The boys are requested to climb one of the slopes and make a sketch of the fall from the side, noticing particularly the way in which the water leaps over. They are at once struck by the fact that the upper rocks project over the lower ones, and the water is shot out some distance beyond the face of the rock (see Sketch I in Notes of Lesson), so that it is possible to walk behind the fall. A few of the steadier boys are allowed to do this and test the hardness of the strata at the back. These strata are found to consist of very soft layers of shale, belonging to the Coal Measures. The lads can see that these shales are soaking wet from the spray cast up by the falling water ; indeed, they get a slight wetting themselves.

One more bit of investigation, and they will be in a position to consider the reason for a fall being there at all. The rock at the top is found to be harder than the soft shales underneath.

The boys are now encouraged to enlarge their sketch by

adding a diagrammatic section of the rocks underneath the fall. (See Sketch II, page 60.)

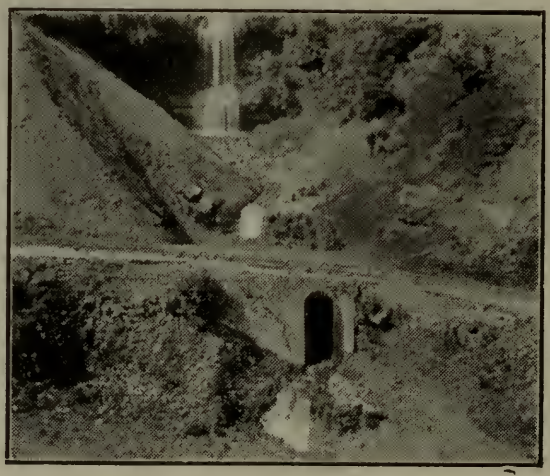
Some questions follow—

"What will happen when more of the soft rock is washed out from underneath?"

"The whole mass above will come tumbling down."

(The boys are invited to put a line showing the new position the water would take.)

"What will happen then?"



A YOUNG NIAGARA CUTTING ITS WAY BACK INTO THE HILLSIDE

"The spray will again excavate the soft shale and the same thing will happen again."

"What, then, will the fall continue to do?"

"It will move back farther into the hillside."

(Let the boys add other dotted lines showing successive stages.)

"What will be left behind?"

"A narrow gorge, where the stream has been at work."

Having looked forward, the scholars may now be encouraged to look backward and reconstruct the scene when the stream

first began to work. As the fall is now receding to the right (of the sketch) the start was evidently made to the left, and as we retrace our steps we come out into the main valley once more. Some of the boys will probably indicate this spot as the original commencement. Before accepting this as conclusive, we can look for other examples farther down the hillside. These are not wanting. A few yards beyond, water is streaming out and trickling down the face of the rock. It has evidently done so for a short time only as little wearing action is apparent. But not far away, another little torrent may be seen busily at work trying to lengthen its twelve feet gorge.

At one time, then, our Waterfall started on the hillside of the main valley and has since cut its way back into the hillside.

No difficulty should be experienced in getting the lads to add dotted lines, showing the complete path of the fall, as in Sketch III.

Now comes an important question.

" Why does the stream still have its sharp fall ?

" Why has it not done like most other streams, that is, cut its way back at gradually decreasing angles ? "

The boys look at their sketches again. At no time is there anything like a sloping river bed ; there is always a fall. Why is this ? Because, before the stream can cut its way through the hard rock at the top, the spray dashing on the hard grit below washes out the soft shales, and so undermines the upper stratum. The debris at the foot is soon removed.

" On what does the height of the fall depend ? "

Height of Fall

A little thought will show the young students that it is on the distance between the two hard strata, or the thickness of the soft coal shales. This is seen also in the other examples examined lower down the valley.

Having observed some waterfalls in their infancy, the young students should now be in a position to grapple with the larger specimens provided by the Clydach itself. Close at hand we have the same kind of fall on a larger scale, the water leaping over a hard ledge, softer strata being excavated underneath. In this case, it is possible to scramble down the stream for a hundred yards or so, precipitous rocks on each side, and it will be a dull boy who cannot see that this large and deep glen has been formed by the fall receding up stream.

A little lower down we have yet another useful lesson. Here, there is no single "fall," only a succession of little cascades.

"What is the reason?"

Let us examine the rocks on each side of this small tributary with our hammers.

All the rocks are found to be extremely hard. There is no soft layer, therefore no undermining with the consequent tumbling down. There was a fall at first when the stream commenced to trickle down the side of the Clydach valley side. But it cut its way back at ever decreasing angles, though it was hard work. Rain, wind, and frost have had little power here. Steep slopes remain on each side of the stream, which, though broken by debris, comes down at a fairly regular angle.

Shape of Waterfalls

Most of the falls have a horse-shoe shape. Let the boys try to find the cause.

Take them to the top of the fall where they can sketch its shape and then ask them to watch the water as it falls over.

"Where is the water running swiftest?"

"In the middle."

"What effect will that have on the edge of the rock?"

"It will be worn away faster than at the sides."

" What effect will it have on the bed of the stream ? "

" It will be deeper in the middle."

" Yes ? "

" More water will flow in the middle of the stream."

" You have, therefore, not only a swift current, but a larger volume of water." Yet another reason should be obtained from a visit to a fall lower down.

At this time there is not enough water to spread out over the whole bed of the river, though there would be after heavy rain. The comparatively small force of water available is applied at one part—the middle. The photograph shows a near view of this volume of water snapped from a bridge above. The smoothed surface with hollow pot holes makes

SUMMER STREAM FROM ABOVE

it clear that in winter the water rushes with force over the whole of the river-bed.

The " fine weather " stream is smaller, but is at work the whole year round, cuts deeper, therefore, and so helps to wear back the fall in the middle.

There are, therefore, at least three causes tending to give a horse-shoe shape to a waterfall.

Notes of an Open-Air Observation Lesson on a Waterfall

To Children of Standard VI or VII

Each child requires a hammer, note-book, and pencil.

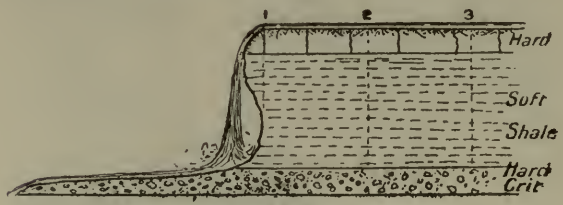
Points to be Observed and Explained

1. *The water shoots out over a ledge of rock at the top, and has a "cave" behind it.*

Sketch to be made from side, to show this.

SKETCH I
THE WATERFALL FROM THE SIDE

Test the hardness of the rocks at the foot, behind, and at the top of the fall. Show these in diagrammatic section.



SKETCH II
ROCKS ADDED

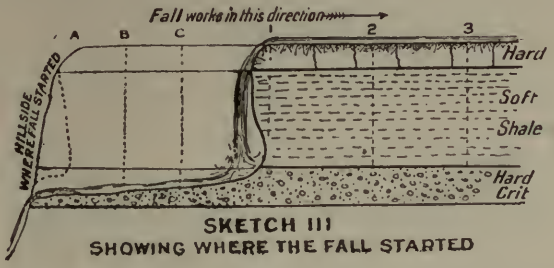
Spray from falling water excavates the soft rock.
Overhanging portion falls.
Show new position by dotted line 1.
Successive positions shown by 2 and 3.

2. *The Waterfall is at the end of a gorge with steep sides.*

The fall constantly recedes into the hillside.
Let boys reconstruct past history of stream.
Show this by dotted lines in sketch.

Steep slopes are left on each side.

This fall is caused by a soft stratum being between two hard ones. The height depends on the thickness of this soft layer.

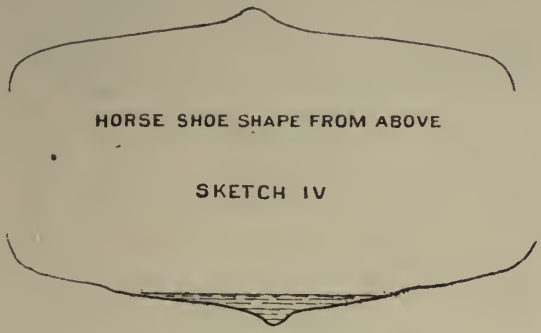


SKETCH III
SHOWING WHERE THE FALL STARTED

When the rock is of uniform hardness, a glen may be formed, but the stream gradually decreases its angle of slope, passing from a fall into a series of cascades.

3. *The fall has a horse-shoe shape.*

Let class sketch shape of the rock edge from below and above.



HORSE SHOE SHAPE FROM ABOVE

SKETCH IV

OUTLINE OF ROCK EDGE FROM BELOW

Observe flow of water—

(*a*) It runs strongest in the middle.

(*b*) A deeper volume of water is found there.

(*c*) The stream flows in the middle all the year round.

CHAPTER VII

The Hill

Hills and mountains must be studied out of doors if they are to be understood at all thoroughly. The young child—certainly in London—usually has a hazier idea of hills and mountains than of rivers, capes, and bays, or even volcanoes and glaciers. The sand model may show him that the hill is a kind of heap—with a base, slopes, and summit, but unless he has actually ascended to a fair height, he has no conception of the stiff climb, the ever-increasing outlook, the clearer, colder atmosphere, the change of vegetation, and, above all, the grand feeling of awe and solemnity one experiences on the summit of a mountain.

Hills are not as useful industrially as rivers ; they are more sparsely populated than plains and valleys, and roads and railways carefully avoid them ; but we shall do the child a real service by imparting a taste for hill-climbing, for a holiday spent on the lonely hills in later life will bring as much health as a trip to the crowded seashore, and will be far more likely to enlarge his mental and moral vision.

To understand Rivers we must acquaint ourselves with the Hills, which give them birth, and for this reason alone the teacher of Standard I or II should endeavour to give at least one open-air lesson on " A Hill."

An isolated peak is of more value for a lesson than a range of hills or escarpment, for then it is possible for the children to have a good view in all directions.

London Hills

In North London we have Parliament Hill and Hampstead Heath—fairly typical hills, though of no great altitude, the

latter being about 450 feet. One Tree Hill and Shooters' Hill are perhaps the best within reach of South London teachers.

Except in the Eastern Counties, country teachers will find little difficulty in getting their children to the top of a hill, whilst in the west the hills and mountains are present in such numbers and variety that quite a considerable portion of the out-of-doors lessons may well be given on them,

AN OPEN-AIR LESSON ON HAMPSTEAD HEATH

especially as quarrying or mining industries will probably be connected with them.

Action of Streams

Little boys in Standards I and II will soon learn the ordinary geographical definitions of hills—base, slopes, etc. But they should also be encouraged to notice the way in which the hills are constantly being denuded by streams running down their slopes. They will readily connect hillsides with the sources of rivers, and it will not take them long to find out that the easiest way up a hill is along the path cut by a stream.

But it is not always advisable to follow the easy path.

The steepness of a hill is one of its qualities which should be brought home to young minds, and this is best attained

STANDARD II BOYS FOLLOWING A WATER-COURSE DOWN HAMPSTEAD HEATH

by letting them attack the steepest incline which may with safety be taken.

It is, however, a good plan to make the *descent* by the side of a stream, when that is possible. Our Hampstead Heath Hill furnishes capital fun to the little boys by means of the channels worn out of the gravel by the streams which pour

down its sides after rain. The photograph shows some little seven-year-olds following in Indian file one of these channels as it wanders in and out, across paths, and between gorse bushes.

At the Summit

Arrived at the summit, a good deal should be made of the extensive view to be obtained, and all should try to recognize as many distant objects as possible. The compass may be used with advantage here. By the aid of a map and compass

STANDARD II BOYS SKETCHING DISTANT HILL OUTLINES FROM THE SUMMIT OF HAMPSTEAD HEATH

guesses can be changed into certainties. It is a good exercise to encourage the children to estimate the distance of some of them. This will be made all the more vivid and interesting if the class is allowed to imagine itself to be a field battery firing at an enemy.

Hill Outlines

From the summit other hills will probably be visible. If so, a profitable quarter of an hour may be spent in making sketches of their outlines. Some little direction will be necessary, or the boys will crowd their sketches with unnecessary lines. But observation of Hill Outlines is one of the most

valuable aids to Scenery Study. If little boys are trained to sketch these outlines, they will ever after look at a hill with added interest. Its outline will be compared with others, fresh beauties in Nature will be recognized, and a useful foundation will be laid for the more serious work which will be attempted in later years, in the direction of accounting for the shape of hills, by studying the structure and arrangement of the rocks underneath.

In this connection the youngest boys may be encouraged to observe and take specimens of the various strata encountered during the ascent, though they may be too young to understand why hard rocks produce steeper slopes than soft ones.

Notes of an Open-Air Observation Lesson on a Hill

For Children of Standards I and II

Boys take Pencil and Note-books. Teacher takes a Compass

Time, $1\frac{1}{2}$ *hours*

Where to go.	Questions to be Asked and Things to be Observed.	Things to be Learnt.
1. Take the class to Parliament Fields, thence to lowest Highgate Pond.	Tell boys to look to the West. What do they see ? (A hill.) Make a sketch of its outline. What kind of shape is it ? (Rounded.)	Parliament Hill has a rounded outline.
2. Ascend Parliament Hill. The boys may be allowed to race up the last few yards.	Why are you breathing so hard ? (We had to climb.) What did you climb up ? (The side of the hill.) Was it steep ? (Not very.) What was the ground like underneath ? (Probably dirty, being clay.) What can you see now ? (St. Paul's, etc.) Could you see them from below ? (No.) Why	The sides of a hill are called its slopes. The top of the hill is called its summit.

Where to go.	Questions to be Asked and Things to be Observed.	Things to be Learnt.
	not ? (Because we were not high enough.) Why are you holding your hats on ? (It is windy.) Is it colder or warmer up here? (Colder.) Can we get any higher ? (Yes.) Which way ? (Hampstead Heath or Highgate.)	
3. Walk along the Ridge. Ascend Hampstead Heath to the Spaniards. Let the boys again run up the last few yards.	Was that any steeper ? (Yes.) Look down and see what the ground is made of. (Pebbles, gravel, etc.) Was it dirty underfoot ? (No.) Why ? (Because the rain soaks through the gravel.) Let the class face the sun. It is now about 3.30. Where should the sun be at this time ? (Half way between S. and W.) Take a half-turn to the left. What are you now facing ? (S.) Let us mark the N. and S. line on the ground. Now the E.W. Can you see any other hills ? Yes. Do you think you can see farther than on Parliament Hill ? (Yes.) Why ? (Because we are higher.) Try to make a sketch of those hills in the distance. In which direction do they lie ? About how far are they away ? How long would it take to walk to them ? Can we get any higher now ? (No.) Why ? (Because we are on the very top.) What is the difference between the summit of this hill and the other we were on ?	Hampstead Hill is rather steep and is made of gravel. We can see a long way into the country. It is nearly 500 feet above the sea.

Where to go.	Questions to be Asked and Things to be Observed.	Things to be Learnt.
	(This is flat and has a road running along it.)	
4. Let boys follow one of the stream channels towards Golder's Hill.	What do you notice on the slopes of this hill? (Bushes, gravel, little ditches.) Let us follow one of these ditches and see where it leads to. (Boys follow a gully in Indian file till they come to a little pond.) What sort of a walk have we had? (A steep one, a thorny one, a curly one). Who made this long ditch? (The rain.) What did it do with all the gravel? (Carried it down.) Where to? (The pond.) Can you see any of it? (Yes.) What would happen to the pebbles as they came down? (They would get broken up.) What would they make? (Sand.) Where would the sand go to? (Answer probably delayed for further help.) Is this hill getting bigger, then, or smaller? (Smaller.) Can you tell me any kind of hill which does get bigger? (Volcano.)	Streams start on the sides of a hill. They rush down its sides and keep on wasting the hill away, carrying the material into a river and so out to sea.

CHAPTER VIII

The Mountain

In the last chapter we attempted to show what use might be made of a hill in teaching simple definitions to little boys in Standards I and II. In the present chapter some suggestions

THE SUGAR LOAF FROM ABERGAVENNY
(*Rholben on the right*)

will be offered for more advanced work with older children, and although a mountain is supposed to be visited, it will be quite evident that most of the work could be taken on heights under 1,000 feet. The Sugar Loaf, near Abergavenny, an isolated peak of the Black Mountains, is taken as an example because it is a typical mountain of average height, the stratification of the rocks is simple, and it is a fairly easy matter to work out its life history. It is not suggested that all the subjects dealt with should be attempted in one lesson. They

would provide the material for five or six half-day lessons at least.

Preliminary Work in the Classroom

Contour maps are particularly useful in studying a mountain. To do the thing thoroughly it is a good plan to buy at least three different sets of maps drawn to different scales.

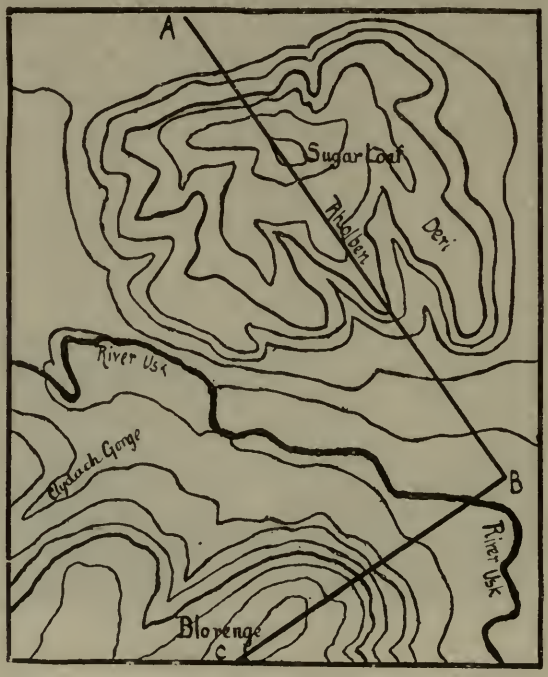


Fig. 1. CONTOUR MAP OF SUGAR LOAF AND BLORENGE

Bartholomew's two miles to an inch are splendid maps. Not only are the contours given, but the different heights are coloured, greens for the lower and browns for the higher altitudes. They show at a glance the contour of the land over a considerable area, and are remarkably cheap at a shilling.

The Ordnance one-inch maps show more detail, and will probably be best for making hectographed maps and sections for class use. These, too, are sold at one shilling per sheet.

Then we have the six-inch Ordnance maps which show pretty well every house and tree. The teacher will find them invaluable for deciding the exact height at any particular spot.

As a rule, it is advisable to give the scholars very little previous information as to what they will see on a school journey. In the case of contour work, however, it will be well to cyclostyle a simple contour map of the district, explain thoroughly what it means, and then let the children draw a section along a given line from the data given by the map.

Fig. 1 is a contour map of the Sugar Loaf and the Blorenge, a mountain on the other side of the Usk. A good number of copies are printed, as a fresh copy may be required by the boys for each ascent. In the preliminary classroom lesson the scholars would draw a line A B from Abergavenny to the summit, which would approximately follow the path of ascent. Another line would be drawn from B to C across the top of the Blorenge. (A straight line will often show what is wanted, but in this case we wish to obtain the gradients on the ascent of the Sugar Loaf as well as the outline of the Blorenge.) The line A B C is drawn below (straightened out), the position of each contour is ticked off, and the vertical frame-work erected. (Fig. 2, page 82.) Each inch of the horizontal scale represents 5,280 feet, each 100 feet of the vertical scale would, therefore, require about $\frac{1}{50}$ in. But this would not bring out the gradients with sufficient distinctness, and it is usual to exaggerate the vertical scale. In this case a useful section is produced by letting $\frac{1}{8}$ in. stand for 200 feet. The eighths are readily set up at the side from the ruler and the frame-work constructed. Perpendiculars are run up from the 200 point to the first line, from the 400 to the second, etc. When the points of contact are joined, the contour of the two mountains and the intervening valley appears, the height being exaggerated about three times. (Fig. 3, page 82.)

We are now in a position to use the cyclostyled contour map and the drawn section on the mountain itself.

(1) The Contour Map on the Mountain

Abergavenny is 200 feet above sea-level, and so the first contour line passed will be 400. The points at which the road and lane cross the first two or three lines can be ascertained from the six-inch map. The distances from the 400 to

ASCENDING THE SUGAR LOAF

the 600, and the 600 to the 800, etc., should be noted. The scholars will soon see that, as the lines get closer together, the path becomes steeper, and they will learn the first important lesson the map has to teach, viz., that close lines show a steep hill. A rough attempt may also be made to check the altitude by reference to surrounding hills. At 900, they will be on a level with the Little Skirrid; at 1,600, with the Holy Mountain; and at 1,800 with the Blorenge. Whilst ascending the steep slope of the Rholben, it should be possible to fix the position of, say, the 600 and 800 lines, and let some of the boys climb straight up, whilst others take one of the paths which zigzag

up the slope. To get an easier path, these have lengthened the distance between the two lines. (Query: How would a railway which must not have a steeper gradient than 1 in 40 ascend the slope ?)

The last part of the ascent is very steep, and the mountain is cut into by several streams. At a spot like this, where the whole mountain slope is unenclosed, it will be a good plan to

Photo by *F. Wilton*

ON THE SUMMIT OF THE SUGAR LOAF

fix on one line—say the 1,500—and let the class follow it round in Indian file. The children must make a path for themselves at that level—never going up or down but following this level wherever it leads them. They will find that a little valley takes them *in* to the mountain, being nearest to the summit when they cross the stream, whilst a shoulder brings them out again. This is the second lesson which a contour map teaches. Valleys bend *in* to the highest point, spurs and ridges project *out*.

(2) The Barometer on the Mountain

If the teacher is able to obtain the use of an Aneroid barometer, many useful lessons may be learnt. As each contour

line is crossed, the reading of the aneroid should be taken and entered either on the boys' maps or sections. It will be found to fall steadily about $\frac{1}{10}$ inch for every 90 feet. On the next ascent by a different route this fall should be used to find the height at different points, and its accuracy then checked by reference to the six-inch map.

(3) The Thermometer on the Mountain

Something similar may be done with the thermometer, only

SUGAR LOAF FROM THE WEST

the temperature is likely to vary much more during the day than the air pressure. It will be necessary, therefore, to have a double record kept. Children in the school would make a chart showing the temperature every half hour, whilst the young mountain-climbers would take the temperature at the same times, entering them in their note-books by the side of the altitude.

On comparing the two records, they will find that the thermometer falls steadily with every increase of altitude, and they will then be able to make a calculation of its rate. Then,

also, they will be in a position to see why the mountain is often covered with snow when the valley is free. They should then be encouraged to look around for other effects of this, on the mountain itself. What about the trees—why are they so small and stunted ? Why are the plateaux not cultivated ? Why do not people build houses up there ? What difference is there in the flora ? (Short grass, bracken, wimberries, and mosses.)

(4) The Compass on the Mountain

The compass can always be used on a school journey, but never to such an advantage as on the summit of a mountain. The children will admire the grand panorama of distant heights, and be curious to know what they are. They may well be encouraged to find them out for themselves, by the aid of the compass and map, and show by arrows on their own map the direction in which the distant objects lie. It is good fun also to estimate the distance of the other mountains, and then check them by measuring with a ruler according to the scale on the map.

(5) The Hammer and the Mountain

Boys dearly delight to use the hammer on a school journey. In this case there need be no fossil-hunting. The scholars are simply encouraged to do a little "prospecting," to find out the kind of rock which makes up the mountain, as a preliminary to solving its history. Even boys in Standards III and IV may be allowed to do this sort of work. Wherever the rock is laid bare by stream, quarry, or precipice, it is examined and a note made on the section at its proper height. Most hills, and practically every mountain, have exposures of some sort. Where the bedding of the rocks can be traced, the angle of inclination should be marked by an arrow. In the case of the Sugar Loaf, the following rocks are met with :—Marl,

Red Sandstone (R.S.), Quartz Conglomerate (Q.C.), and, at the top, Grey Grit (G.G.). (Fig. 4, page 83.)

Several suggestive questions may well be given here—

Where are quarries generally found ? (On the hillsides.)

Why ? (Because the rock is exposed better.)

Photo by *F. Wilton*

LUNCH ON THE MOUNTAIN

Are mountains of any commercial use ?

What is the commercial use of rivers ?

Have mountains any other uses ?

How the Mountain was Made

The teacher who has hills or mountains in his vicinity should certainly make every effort to find out why they are there, and how they came to have their present shape.

The rock-structure of some of our heights is rather complicated. Snowdon, for instance, consists of greatly contorted

slates with volcanic rocks in between. But where the mountain is composed of stratified rocks without much disturbance, the teacher will soon learn its life-history, and he may well let his upper standard children tackle the important question—"How has the mountain been made?"

The first thing is to get the rocks filled in on the section, showing the way they are arranged. The information can generally be obtained from the geological maps or memoirs issued by the Geological Survey. The former show the rocks as they are found on the surface, while the latter usually give details concerning the dip of the strata, and often rock sections across the heights as well.

Teachers in London may always depend on getting what they want by paying a visit to the Library of the Geological Museum in Jermyn Street. The officials are extremely courteous and obliging, and always ready to put teachers on the right track.

We have seen how the children could explore the mountain and make notes on their own sections of the rocks they found exposed at different points. They will have noticed also that, generally speaking, the strata are fairly horizontal. From the Abergavenny Memoir we find that the strata dip slightly towards the Usk, but, as this cannot well be found out by the boys themselves, the teacher must give them this information.

If time permitted, the opposite mountain, Blorenge, should be explored as carefully as the Sugar Loaf, before proceeding to this stage. But in any case, the rocks must be filled in for the Blorenge also, as the two mountains are intimately connected with each other in structure and life history.

Fig. 5 (page 83) shows our section thus filled in. This, of course, will be done in the classroom from a blackboard sketch drawn by the teacher.

The sharp scholars will soon notice that the rocks found on

the Sugar Loaf are found in the same order and with about the same thickness on the Blorenge. The Old Red Sandstone was probably deposited in a big lake. Would it be laid down in two halves, cut off sharply like this ?

It will be evident to the boys that the rocks stretched across the intervening space at one time. Let the class reconstruct this state of affairs, as in Fig. 6 (page 84).

A LESSON ON MOUNTAIN-CARVING

Previous lessons will enable the boys to see that the contraction of the earth as it cools has forced these rocks up from below sea-level to their present height.

At this interesting point the matter may be left with the scholars to think about till the next school ascent of the mountain.

What the Usk has Done

The top of the steep Rholben slope will be a good spot at which to take up the subject again. There is a clear, uninterrupted view of the valley with the Blorenge Escarpment to the other side. By referring to the last sketch made in the schoolroom (Fig. 6), the pupils will see that at one time in

would have been possible to walk straight across from the Sugar Loaf to the Blorenge.

What has caused the enormous gap between them? Earlier lessons on smaller valleys will have prepared the class to suggest that the Usk has been the cause. It seems hard to realize, but there is little doubt that long ago the Usk ran along the top of the rocks and has since cut its way through to the bottom layer of Marl.

A boy may possibly ask whether the Usk really did run at a height of 2,000 feet above sea level. It might have done so. But these rocks were once under the sea, and the Usk may have started to work before they were forced up to their present elevation. In this case, the river would have been carried up with the strata.

Why is the Valley so Broad?

Is a question sure to be asked. Did the river ever stretch right across this wide valley? Probably not. The river cuts vertically down through the strata; the weather and tributary streams wear down the perpendicular sides which the river would form if it worked alone. The Usk has done most of its cutting, for at Abergavenny it is only 200 feet above the sea, and so cannot go down much farther. But rain, wind, frost, and tributaries continue to widen the valley.

The Cause of the Different Slopes

On the summit, the class should be encouraged to get a clear idea of the shape of the mountain. The contour map will help. There is one central peak with three great spurs stretching out to the south.

What separates the spurs? Deep valleys.

What has made the valleys? Streams rushing down the hillside.

These have been seen actually at work, and one of them is cutting its way right into the heart of the central peak itself.

The long spurs, then, represent the parts of the mountain that have not been cut into by the little tributaries of the Usk.

But at least two layers of rock have been removed from the Rholben. Where is the Quartz Conglomerate? Where is the Grey Grit?

If the class examine the comparatively small cap of Grey Grit on the summit, they will see that rain and frost are fast breaking it up. The slopes are strewn with debris which has fallen from this mass. It is, however, very hard and is resisting the weather well.

The Conglomerate underneath is more easily broken up, and once the protecting Grey Grit goes, the other rapidly follows. Hence, the long slope of the Rholben has been almost entirely denuded of the friable Conglomerate. The Red Sandstone below is more homogeneous, and holding out against the powers of denudation presents a bold steep slope to the climber.

The Future of the Sugar Loaf

What will happen when the last bit of Grey Grit has been broken up by Jack Frost? The Conglomerate will fast disappear. Look across at the Holy Mountain. Sketch its outline—and you have the result.

When the Sandstone goes—what then?

Only the softer Marls will be left—which will not last long.

There it is—in the Little Skyrrid—only 900 feet high.

The Past Life of the Sugar Loaf

These two hills show what the downward path of the mountain is likely to be. Away to the west, Pen Cerrig Calch shows what it *has* been. It not only has the steep Grey Grit slope, but above that is another layer of hard rock, the next one present on the Blorenge, the lower part of the carboniferous rocks. At one time, the Sugar Loaf had it, too. (See thick outline in Fig. 7.) What the Sugar Loaf is to-day Pen Cerrig will be in the future.

Pen Cerrig (2,300 feet), Sugar Loaf (2,000 feet), Holy Mountain (1,600 feet), Little Skyrrid (900 feet), show the successive effects of denudation in a most striking manner.

It will be instructive and interesting at this point to let the boys work out on the Fig. 6 diagram the successive stages of

LEAVING THE SUMMIT OF THE SUGAR LOAF

the Usk's work of valley making. The thick line on Fig. 7 shows roughly the outline of Pen Cerrig Calch.

Why is the Sugar Loaf Isolated ?

Blorenge and Pen Cerrig are the extreme edges of great Mountain masses. Sugar Loaf is isolated entirely. Why is that ?

Because our mountain has been attacked, not only by the Usk, but by two rather large tributaries, the Gavenny on the east and the Gwyrne on the west and north. Rivers have been working all round it so that a wide expanse has been opened up to atmospheric denudation. Pen Cerrig is being cut off in a similar manner.

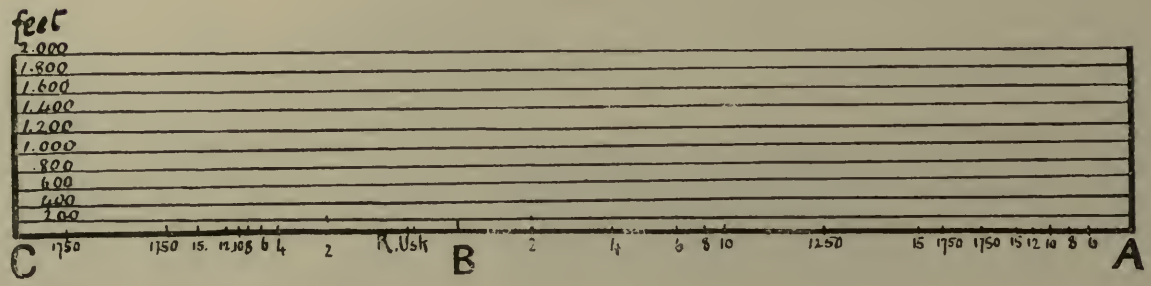


FIG. 2. FRAME FOR PLOTTING OUTLINE OF MOUNTAIN, WITH CONTOUR LINES TICKED OFF AT PROPER DISTANCES

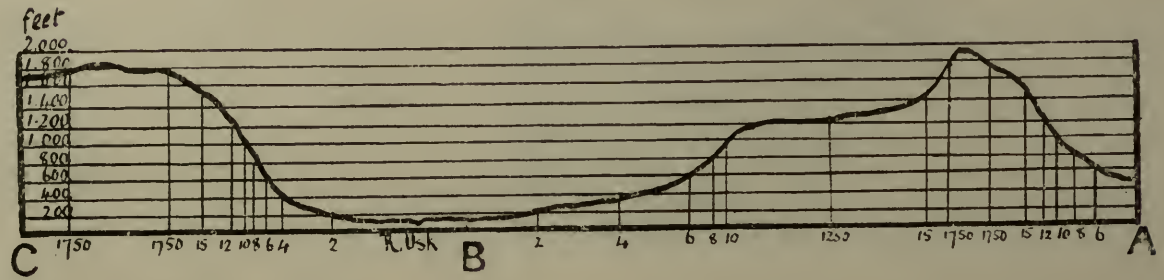


FIG. 3. VERTICALS SENT UP TO THE REQUIRED HEIGHT, AND THE POINTS JOINED TO FORM THE OUTLINE

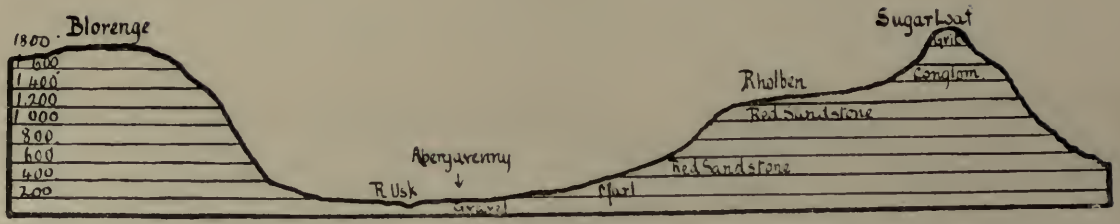


FIG. 4. ROCKS INSERTED FROM CHILDREN'S OBSERVATIONS ON THE MOUNTAIN SIDE

FIG. 5. SECTION ACROSS THE SUGAR LOAF AND BLORENGE, SHOWING ROCK STRUCTURE AT PRESENT, AND THE PROBLEM TO BE SOLVED

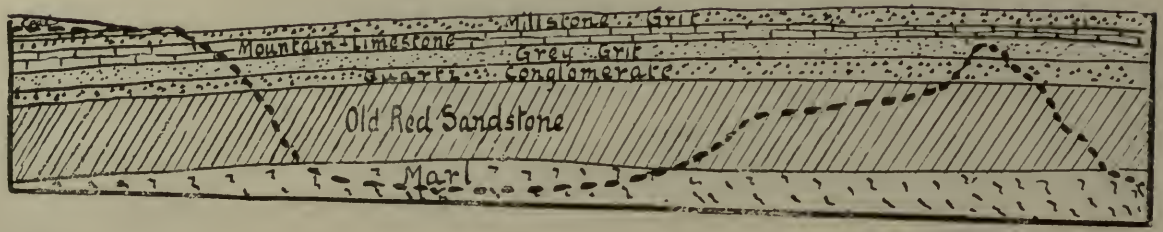


FIG. 6. HOW THE STRATA PROBABLY LAY BEFORE THE USK COMMENCED ITS WORK OF VALLEY-CUTTING

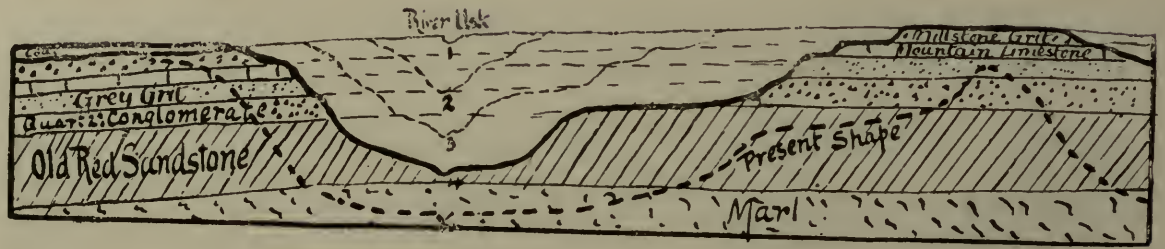


FIG. 7. THE SUCCESSIVE VALLEY SLOPES FORMED BY THE RIVER USK. THE THICK LINE SHOWS APPROXIMATELY THE PRESENT OUTLINE OF PEN CERRIG CALCH, AND THE FORMER SLOPE OF THE SUGAR LOAF

CHAPTER IX

The Sea as a Nature Study

London teachers may not have many opportunities of giving lessons at the seaside, though it is good to know that schools are taking day trips or long distance excursions to it in increasing numbers. But for those near the coast there will be no difficulty in finding material for instruction either for the little boys of Standard I or the Training College Student. The sea not only does its own peculiar work of denudation, but it lays bare all kinds of rocks, revealing their structure and stratification, beside having a wide and varied flora and fauna of its own.

General Observation of the Sea Coast

Without going into the why and the wherefore of things, a very useful preliminary lesson may be devoted to the simple observation of the seashore itself. If possible, take the boys to a cliff or hill commanding a good view.

What is the contour of sea and land line ? Does it stretch for miles in a straight line, or is it broken up into capes and bays ? Then direct attention to the land—is it flat or are there cliffs ? Are the cliffs high or low—steep or gently sloping ?

Going down to the shore, the beach is examined. Is it composed of sand, mud, shingle—or is it bare rock ? Does the sea go out a long way at low tide ? Measure the distance by pacing at various points—is it constant ?

If sandy—is the sand wet or dry? If shingly, examine the pebbles—are they large or small—rounded or subangular? A careful examination of the rocks should be made, an attempt made to identify them, and, if stratified, a typical piece should be sketched. Sometimes a sloping path runs

A LESSON ON THE SEASHORE

down the side of a cliff, and then it is possible to make accurate measurements of the thickness of each layer. Such a "slip" has been cut down the cliff side between Sandown and Shanklin. Quite a valuable afternoon's work could be put in with the measurement of the various strata from top to bottom.

The cliff should not only be sketched lengthwise, as seen

from the sea, but also in profile whenever it is possible to get a silhouette. These sketches, especially if combined with information concerning the rocks composing it, will supply data for lessons attempting to explain the effect of sea on land.

Ripple marks provide popular sketching material for boys. A small portion should be lined round and the pupils asked to make a very careful drawing of the ripple lines. If this is not done they will put in a number of parallel lines and miss the whole point of ripple mark arrangement. A different form of observation may be obtained by watching the waves as they come in. Count the seconds by the aid of a watch and ask the children to put down the time between each wave break. Is this constant or does it vary ? Are all the waves of the same height ? They will possibly find that a bigger wave rolls in with a certain amount of regularity.

How the Sea Works

After general observation of the seashore would come an enquiry into the way in which the sea attacks the shore and how the coastline has assumed its present outline.

If warm enough, it is a good plan to start the instruction with small parties of boys when they are bathing in the sea. It will not take them long to learn that the waves have great lifting power, even in calm weather, and their imagination will allow them to form some estimate of its force in the storms of winter. They will notice, however, that though thrown with some force on the beach, they are not so badly hurt as if they were thrown down in air instead of in water. Things weigh less in water. They will also feel the backward pull of the water as it runs down off the beach, and they may have to hold on to prevent themselves being rolled back with the pebbles, which can be heard rattling over one another.

The masses of water themselves wash away the softer

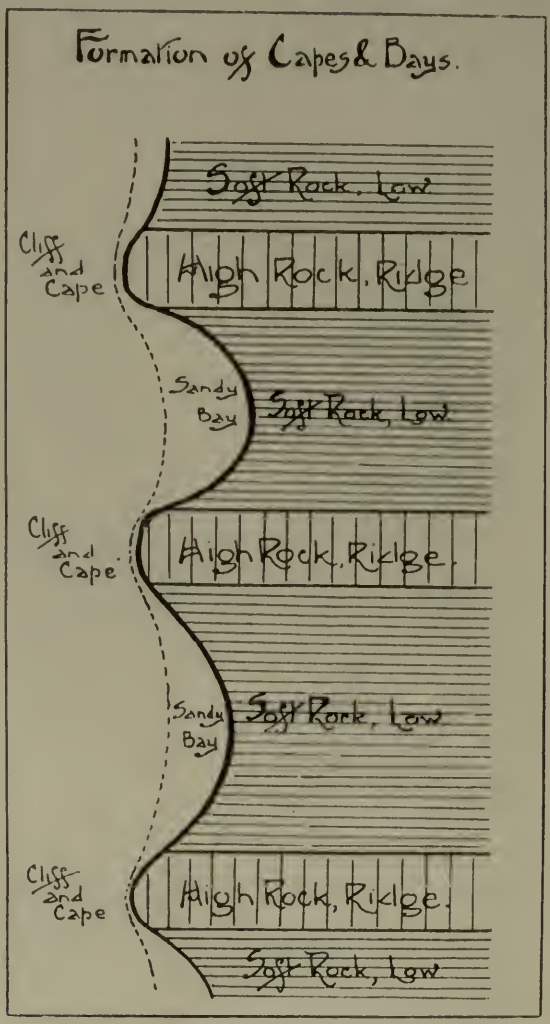
RIPPLE MARKS AND THE SEA'S UNDERCUT INTO THE CLIFFS

shore rocks, but they have very little effect on the hard rocks. The waves get their power from the pieces of rock they

THE FACE OF THE CLIFF, SHOWING THE EFFECT ON HARD AND SOFT STRATA

are able to pick up and hurl at the cliffs. By this constant battering the hardest rocks are eventually worn down.

The point to be driven home by as many examples as possible is, that the rocks present an unequal defence to the marine artillery. Soft rocks, like clay and shales, fall easy



victims—hard limestones, sandstones, and granites stand out boldly and only give in after years of persistent and irresistible cannonading. And this is the case either in the horizontal coastline or the vertical line of the cliff.

Where the cliff consists of alternate layers of hard and soft

rock, this will be very plainly shown—the hard rocks standing out, of course. Cape and bay tell the same tale as the coast-line. The point is so important that every possible example should be used to drive it home. Where full-sized capes and bays are not available, it will often be possible to find tiny examples—which will, perhaps, be better than the larger ones.

(Note.—The children should not be left with the idea that all capes are rocky headlands. The currents sometimes throw up a projecting heap of sand, as at Dungeness, and not infrequently a river will make a cape by entering the sea obliquely, as in the case of Spurn Point.)

The sea, although working like artillery, has the effect of a saw cutting horizontally into the base of the cliffs. Examples of the sea's " Bite " are not, as a rule, hard to find. We came across several at Shanklin with our boys, and in some cases the undercutting had proceeded to such an extent that it was quite unsafe for boys to go inside. They saw quite plainly that soon the superincumbent cliff would come tumbling down in a heap on the seashore below. There were such heaps not far away—and there were also heaps of a week ago, with the *soft* material all washed away and only the big hard lumps left.

Pebbles

This is a suitable time to investigate the evolution of a pebble. Let the boys stand back and play the part of the sea by hurling stones at one of the fallen masses. They will soon get tired, but they will probably have knocked one or two chips off. Proportion sum—If a class of boys throwing small stones for ten minutes knocked off x chips, how long would it take the powerful sea, working six or seven hours per day, to demolish it ?

Now how are the irregular rock lumps rounded into pebbles ? Throwing them at one another would only break them. What

does the sea do after throwing the boulders at the cliff? It is the *rolling* over one another that rounds off the corners and changes them from angular fragments to subangular and then rounded pebbles.

An interesting lesson could be obtained from pebbles alone. Various shapes could be sketched, and an attempt made to identify the material. The sea rolls everything into pebbles —flint—brick—glass bottles—all are remorselessly ground down in the mill of the sea. Most of the pebbles will be recognized as coming from cliffs near at hand, but not infrequently "foreign" pebbles are found—granite on flint beaches, for instance. Where do these come from? In some cases, perhaps, from passing ships—or from stones deposited on the beach as rubbish; but the sea itself rolls pebbles along the coast for miles, witness the long Chesil Beach, and some pebbles travel a very long distance before being reduced to sand and mud.

Pebbles that show pretty structure (*e.g.*, corals or agates) may be taken home and ground down on a sheet of glass with emery powder. Many of the Devonshire pebbles are worth treating in this way.

The Making of Islands, Ridges, and Bars

On various parts of the coast, masses of rock with all sorts of fantastic shapes stand out isolated in the sea. Several of these are found at the western corner of the Isle of Wight in the form of stacks—"needles" and arches. In each case, the hardness of the rocks or else their peculiar stratification have enabled them to present a longer defence to the marine attack. Islands are frequently formed in this manner, though sometimes they are the tops of hills on land which has sunk beneath the waves.

Stretching out from a rocky headland into the sea a rocky ledge will often be found. The Horse Ledge at Shanklin is a

good example, so is Filey Brig. This ledge is the remaining portion of the cape when it jutted still farther into the sea. As a rule, it is impossible to get round a cliff at high water—sometimes not at all, and it is worth noting that the *high* water line is more indented than the low. It may be possible to walk along the sands almost in a straight line from one cape to another at low water, whereas at high water one would have to go all round the bay. (See diagram on page 90.)

The entrance of rivers always presents interesting problems. Rarely do they flow straight into the sea at right angles to the coastline. In our country we have no deltas, though the large rivers require constant dredging to prevent the formation of sandbanks. But very often the sea throws up a bar of sand or shingle across the mouth, and compels the river to take an oblique course. In the Gower peninsula the stream which comes down from the Bishopstone Valley is completely barred by a pebble ridge—the water having to trickle through the stones to get to the sea.

The Chines of the Isle of Wight are interesting as showing how streams assist in the work of breaking up a cliff, gradually cutting their way back till they have formed a decent-sized valley of their own. They show the river in its very earliest stages.

New Rocks from Old

The seashore forms an admirable place for observing how stratified rocks are made, for it is one of Nature's laboratories. The children see the sand being laid down in layers far out to sea, pebbles being heaped up in irregular layers, streams bringing down rich loads of mud. At Shanklin a chalybeate spring flows from the cliff side and trickles down over the sand. Sand percolated by iron or lime in solution eventually becomes cemented into sandstone. With pebbles we get pudding-stone or conglomerate.

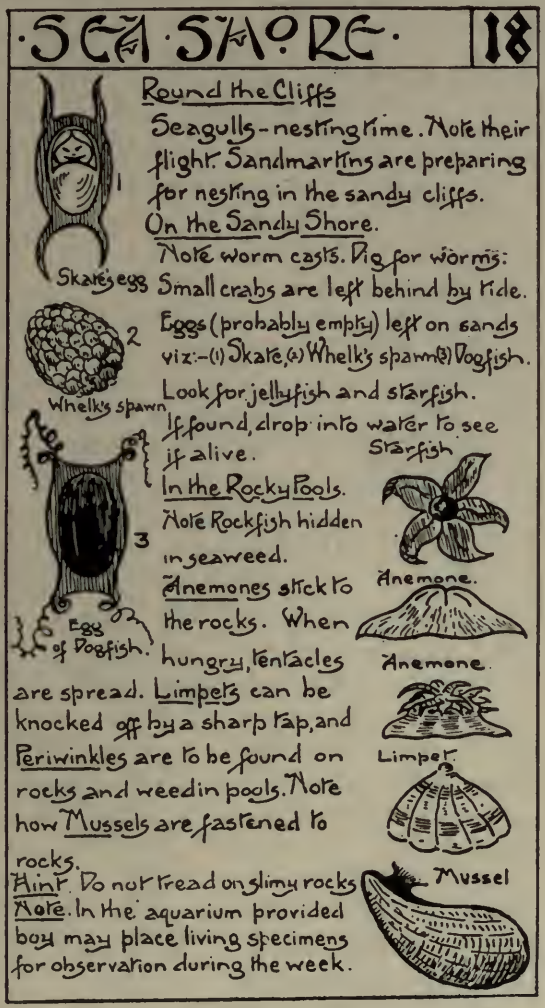
Animals whose shells or skeletons are left on sand do not, as a rule, become fossilized—they break up or are dissolved, but when they fall on mud and are covered up, then fossilization often takes place. This can be shown to the children at many

MAN'S BREAKWATER AND THE SEA'S RESPONSE

places on the seashore, though most of the mud is deposited farther out at sea.

It should not be forgotten that plant and animal remains are not the only markings preserved for millions of years in the rocks. Ripple marks, rain pittings, footprints, worm casts, are all found in rocks that have been formed in estuaries or on the seashore. The various markings on the sands should be carefully noted, so that when found on sandstones

or shales their origin may be recognized. The seashore may be made to teach the children very clearly that by an examination of the structure, markings, and kind of fossils in

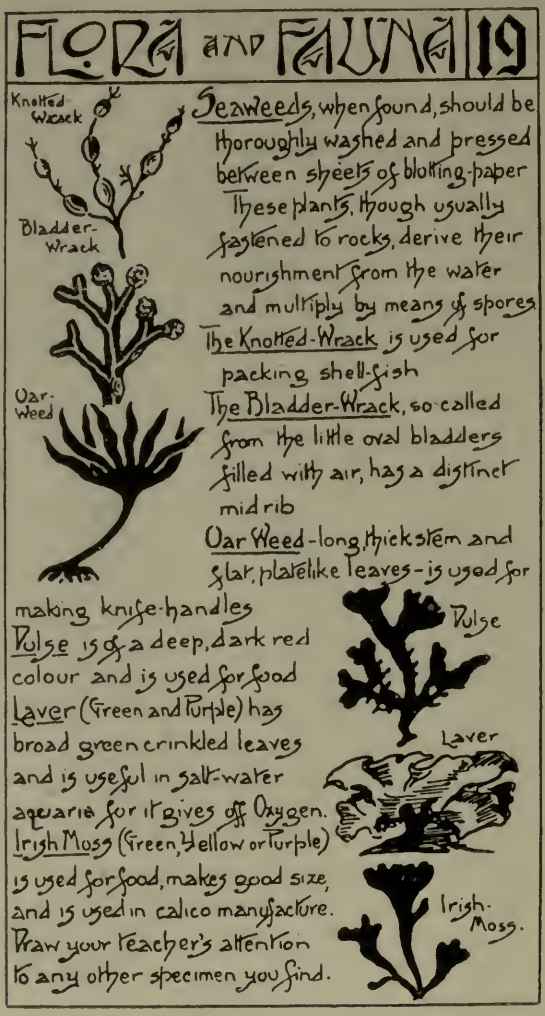

SEA SHORE 18
Round the Cliffs
Seagulls - nesting time. Note their flight. Sandmartins are preparing for nesting in the sandy cliffs.
On the Sandy Shore.
Note worm casts. Dig for worms: Small crabs are left behind by tide.
Skate's egg
Eggs (probably empty) left on sands viz:-(1) Skate, (2) Whelk's spawn (3) Dogfish.
Look for jellyfish and starfish. If found, drop into water to see if alive.
Whelk's spawn
In the Rocky Pools.
Note Rockfish hidden in seaweed.
Anemones stick to the rocks. When hungry, tentacles are spread. Limpets can be knocked off by a sharp rap, and Periwinkles are to be found on rocks and weed in pools. Note how Mussels are fastened to rocks.
Egg of Dogfish.
Hint. Do not tread on slimy rocks
Note. In the aquarium provided boy may place living specimens for observation during the week.
Starfish
Anemone.
Anemone
Limpet
Mussel

a rock it is possible for the geologist to tell how they were made in the first place.

Animal and Plant Life

We have devoted most attention to the work of the sea as a denuding agent, but it will be obvious that a whole course

of lessons could be developed round animal and plant life. Schools at the seaside, which are able to follow this up methodically, may do so with advantage; but where school journeys


FLORA AND FAUNA 19
Knotted Wrack
Bladder-Wrack
Oar-Weed
Seaweeds, when found, should be thoroughly washed and pressed between sheets of blotting-paper. These plants, though usually fastened to rocks, derive their nourishment from the water and multiply by means of spores.
The Knotted-Wrack is used for packing shell-fish.
The Bladder-Wrack, so-called from the little oval bladders filled with air, has a distinct mid rib.
Oar Weed - long, thick stem and star, plate-like leaves - is used for making knife-handles.
Pulse is of a deep, dark red colour and is used for food.
Laver (Green and Purple) has broad green crinkled leaves and is useful in salt-water aquaria for it gives off Oxygen.
Irish Moss (Green, Yellow or Purple) is used for food, makes good size, and is used in calico manufacture.
Draw your teacher's attention to any other specimen you find.
Pulse
Laver
Irish-Moss.

to the sea are occasional, the physiographical side of the sea coast is likely to be of most value, as it throws such a wealth of light on the geography lesson. A couple of pages from a seaside guide book are reproduced to give some idea of the commoner objects likely to be met with.

During a week's or fortnight's stay it would be profitable to have a number of marine aquaria on view in the boys' day room. Some London schools succeed in keeping crabs, anemones, fish, and other sea animals at school. Sea water is obtained cheaply from the G.E.R., but constant aeration by artificial means is necessary, as the seaweed will not supply the air in the way pond weed does in the fresh water aquarium.

Other Lessons

We have by no means exhausted the possibilities of the sea as a study. The sea attacks the land, how does man seek to circumvent it? By breakwaters and groynes of varying description. The disappearance of ships on the horizon will, of course, be one evidence of the Earth's rotundity. The sea not only has its own flora, but the salt sprayed land adjoining has its own special plants, which provide the botanist with ecological lessons.

Ships, harbours, and buoys; lighthouses and forts. Teachers need no hint to utilize them for lessons whenever the opportunity occurs.

CHAPTER X

Clouds

Clouds make an admirable Nature Study for children of all ages, and it is hardly necessary to make a School Journey in order to give an observation lesson on them. The class may sketch and observe them from the playground or even from the desk in the classroom. But it is best to get the children out to an open space—a hill for choice—where they can see the whole expanse of sky and watch the clouds rolling up from the horizon.

Obviously, an open-air cloud lesson cannot be planned for any particular day. The opportunity must be seized when the clouds choose to appear, which they do most frequently and beautifully in spring and autumn.

Cloud-Sketching

We ask the children to choose a cloud and sketch it first. This may be done with pencil and paper, but it is better to supply them with blue paper (such as is used for brushwork) and white and black chalks or crayons. They have then a natural blue background on which to work. This preliminary sketching will open the children's eyes to quite a number of facts about clouds. They will soon be aware that clouds not only move, but that they are constantly changing in shape—and that if they wish to make a cloud-sketch they must be quick about it. A number of clouds should be sketched before any oral work is done ; large and small clouds, clouds on the horizon and some near the zenith.

THE CLOUD WITH THE SILVER LINING

Cloud Movements

After that is the time for questions.

What have they noticed about the clouds? They are moving. Yes, like boys, they can't keep still. Let each boy point to the direction in which his last cloud moved. The chances are they will all be in the same direction, but sometimes the higher and lighter clouds show a different direction. Why are they moving? The wind, of course. Which way is the wind blowing on the ground? Let the children put their fingers in their mouths and then hold them high over their heads. They will at once feel the lightest breeze and be able to point the direction. Quite probably, this will be a different direction from that of the cloud movement, and the children may then be led to see that there are currents at different levels. To what class of men are these currents specially interesting? Balloonists. Here can follow a little talk on aerial manœuvring in order to catch the wind which will carry the aeronaut in the desired direction.

Now ask the children to concentrate their attention first on one, then on another, and then on another cloud, with the idea of discovering whether they are all moving at the same rate. No, they are not; some move rapidly, while some hardly seem to move at all. Why is that? This is usually a poser and requires a little illustration on *terra firma*.

Let the class face in one direction, and place two boys, one at, say, three yards and another fifty yards away. Ask the class to point their fingers straight ahead of them and look along them as if they were firing a pistol. At a given signal, tell the two boys to run their hardest in a straight line across the line of fire.

Now which seemed to go across the finger more rapidly? The nearer boy, of course. They will then see that near clouds are likely to appear to move more rapidly than distant ones,

and further observations may be made to confirm this hypothesis.

Cloud Shapes

Once again direct the boys' attention to a fairly large cloud, and ask them to observe its shape carefully. Does it keep the same shape or does it alter ? The impetuous boy will in three seconds decide that there is no change, but at the end of a minute he will give a different reply. Why ? The cloud is mist and the wind blows it about. Have they seen anything similar at home ? Yes ; steam from the kettle, and the smoke from father's pipe.

Not infrequently, a small cloud will fade away and disappear. It is well to watch carefully for this interesting phenomenon. Older boys may be set to work thinking out the problem why it disappears. The little ones will probably say it has been blown to little bits. The older ones should be able to suggest the invasion of a warm wind or a descent to warmer strata of air, which would cause vaporization.

Colour of Clouds

If the children have been provided with crayons or paints, they will already have a good idea of the colour of clouds.

They are, of course, mostly white and dark grey. Some of the light fleecy clouds are pure white, but the bigger ones show dark shadings. Ask the children to look all round at the clouds and notice where they are dark. Is it always on one side, or anyhow ? Yes, the clouds are dark on one side and light on the other. Why ? Our Standard III boys are unable to give a reason ; so we stand at right angles to the sun when it comes from behind a cloud. " Look at my face. Which is light ? Which is dark ? Why ? " The sun, of course. Now turn round and look at the clouds. " Oh, of course—the light side is towards the sun and the dark is in shadow."

" Let us watch that big cloud just going in front of the sun. Dark, isn't it ? Why ? " Answer comes readily now. " Where is it bright ? " Round the edges. " Ever heard of the cloud with the silver lining ? " Perhaps not—but now they do, and the teacher will, of course, point the encouraging moral of the silver lining which accompanies the darkest cloud in our own lives.

Sunsets

Every " open air " teacher should endeavour to let his children watch a really good sunset with him. Pencils and note-books may be put away, and the whole attention of the class be concentrated on the beauty of the scene.

" The Setting Sun has given
Ten thousand hues to summer even."

Now, if ever, is the time for poetry. Let the fancy have free play. Never mind about *why* the clouds are red now—or *why* the sun looks so big. Watch those shafts of light sent up into the sky like—yes—the spokes of a wheel or the arms of a windmill. The poet Shelley calls them " golden lightning." Nothing in nature, except perhaps the depth of a forest or the top of a high mountain, will appeal to the *soul* of a child so much as a beautiful sunset, and the wise teacher will make it a poetry rather than a science lesson.

Some of the lads will want to take out their paints when they realize the beauty of a sunset, but they should be encouraged to look out for sunrises also, which bring quite a new set of atmospheric effects.

Rainbows and Weather Lore

A teacher may go several years without receiving the honour of a visit from a rainbow during the school journey. But whatever the subject in hand, it should be put aside while the rainbow lasts. The Upper Standards, who keep barometer

FEELING THE DIRECTION OF THE WIND WITH A WET FINGER

and thermometer charts, will be interested in clouds, rainbows, and sunsets from a weather point of view, and they may well be encouraged to look up as many "sayings" as possible to try to find out how far there is likely to be truth in them. A cloud record, kept side by side with the readings of the meteorological instruments, would be helpful in this respect.

Kinds of Clouds

It may be useful to teach the children the names of the commoner types of clouds, but there are so many gradations between one kind and another that it is often difficult to tell which is which. The light, fleecy, white *Cirrus* clouds (from *Cirrus*, a curl) are probably so high up that they are composed of small particles of ice. The heaped up *Cumulus* clouds are shown in the photograph, and on a windy day these are the most common. At sunset and sunrise, one often finds low belts of clouds in layers, and these are called *Stratus*. But there are all sorts of combinations, and we do not attach great importance to our children being able to tell their names, as we do in the case of trees. When Dr. Airey, H.M. Chief Inspector, saw a class at work on Clouds, he asked whether they had had previous instruction on the formation of clouds and their names. We replied that no previous preparation had been given, as this would hinder the object we had in view, viz., observation. Any theoretical instruction, if given at all, would be given at school *after* the lesson. The upper boys would get lessons in Evaporation and Condensation in their Science lessons, but for the little boys in the lower standards we were content to let them sketch and describe the beauties of the clouds themselves.

CHAPTER XI

Snow

We had been giving open-air lessons for some time before the opportunity came for snow lessons on Hampstead Heath. Children cannot be taken out *in* a snowstorm nor during a sloppy thaw. To be useful to the teacher, the fall of snow must be followed by fine weather—in school time—not in the Christmas holidays.

But at last such conditions obtained, and "logging" the change of Time Table, several classes went out on the same afternoon. Children were told to wrap up warmly and ask their parents' consent. Indeed to avoid possible misunderstandings and complaints about boys catching their death of cold, the younger boys were asked to bring a written consent from their parents. Those without remained in the stuffy warmth of the schoolroom. Needless to say, the snow lesson presented entirely new problems, and each teacher tackled them in a different way. It was too cold to ask the children to sketch or take notes, and it was essential to keep the children on the move so that they should not catch cold.

(1) *Colour.* The children were struck by the dazzling whiteness of the snow before the lesson began. Some boys complained that it hurt their eyes, and, on enquiry, it was found that the boys with light eyes suffered worse. Asked to suggest a remedy, one boy remembered that his father had to wear coloured spectacles for weak eyes, and the class readily understood the necessity of some such protection for explorers in the Arctic regions and for climbers in the Alps. It would be an advantage to have

blue glasses available to demonstrate their effect in preventing snow blindness. As the camera accompanied the class, the boys were asked what effect it was likely to have on exposure, and they were interested to find that at three o'clock in the afternoon in February snaps of snow scenes were quite possible.

SNOW *v.* HANDKERCHIEF

Mr. Rose opened his lesson in dramatic fashion by asking his boys the colour of their handkerchiefs. "White," was the unanimous answer. "Take them out and lay them on the snow." The cleanest looked dirty by the side of the pure white of the snow.

(2) *Nature of Snow.* "Take up a little snow carefully and look at it closely." The structure is not seen so clearly as when the flakes fall lightly on a dark coat sleeve. But the boys see that it is crystalline, and some will

have seen pictures of snow crystals in a book. Now we draw on the chemistry lesson by asking how crystals are formed. They grow gradually—bit by bit—and the lads are led to see that snow flakes are frozen crystals of moisture, which have slowly grown, not frozen drops of rain. They are encouraged to look the matter up at home and find out the geometrical shape of snow crystals.

FROM WHAT DIRECTION CAME THE BLIZZARD ?

(3) *The Snowball and its lessons.* "Now take a big handful of snow and make a good hard snowball." The snowball is much smaller in size and this shows that snow is compressible. We cut a snowball in halves, and compare the middle with the outside. Why is the outside hard and icy ? Pressure combined with the warmth of the hand. Pressure and warmth will, therefore, change snow into

nevée—half ice, half snow. We remember that word because it comes in when treating of glaciers.

(4) *Depth of Snow on Ground.* A good deal of fun and a certain amount of exercise may be obtained by sending the boys off with rulers or scouts' poles to measure the depth at different places. At the end of five or ten minutes the boys are called in to give their results which vary from one inch upwards. Why this difference? Sharp boys will notice that the deeper measurements were obtained in hollows, and the necessity of a pole to try the depth in unknown districts is thus made evident.

(5) *A Snow Drift and its lesson.* A quick run to get warm takes the class to a hedge running down the side of the hill. Here the snow is piled high and deep on one side, while for some little distance there is bare grass on the other. Why is this? Obviously the snow has not dropped "as the gentle rain from heaven upon the place beneath," but drifted across at an angle. From which direction did the blizzard come? From the "heaped up" side. By the sun (or compass) this is found to be N.E. Is this a likely direction for a blizzard? Why?

We now ask the lads to suppose that they are caught in a blizzard miles from home—and then to find a place of comparative shelter. The boys scatter along the hedge side in high glee, and some show considerable ingenuity in finding a sheltered spot.

(6) *Snow Tracks.* In the country the recognition of footprints of wild animals would make an admirable subject for study, but on Hampstead Heath those of men and dogs were the only ones available. Mr. Wilton developed this part of the lesson considerably with his class, putting boys first to walk and then to run—noting the difference in the tracks made. A dog's footprints, together with a man's, were discovered and followed for some distance.

Then came a little talk on footwear for snow travelling. What were the difficulties of walking in the snow ? The feet sank in—boys became tired—feet got wet. This led on naturally to a talk on mocassins and snow shoes.

TRACKS UP AND DOWN HILL

(7) *Avalanches and Glaciers.* No open-air lesson would be complete without some attempt to link it up with those grand Alpine phenomena—the avalanche and glacier. The roofs supplied plenty of avalanches during the following days of thaw, but the valleys of Hampstead Heath are hardly steep enough to produce them. At Parliament Hill the boys were able to see how toboggans pressed the snow into a slope of *nevée* and ice, and a

sharp frost after a partial thaw produced plenty of it in the streets a day or two later ; but it was, of course, necessary to draw on their imagination to see how, in the precipitous valleys of Switzerland, glaciers would be formed. (A glaciated stone from Lancashire was brought out from the museum next morning.)

(8) *The Snowball Battle.* The boys naturally wanted to finish up with a game of snowballing, and it was decided to play the battle of Hastings on opposite sides of a very small valley. The little stream in the middle prevented the game from becoming a scuffle. After this, we decided to illustrate the term " strategy " in a simple way. On a ridge, joining the Heath with Parliament Hill, is a circular Tumulus covered with bushes and enclosed in railings. The two armies were placed on opposite sides out of sight, with instructions to make a good stock of snowballs. The defenders were told that the attack might come from either side of the ring. They accordingly kept a watch in both directions, but when a few of the attacking party put in an appearance they all advanced to meet them, and were taken by surprise in the rear by the main portion of the attacking army. Simple strategy, of course, but it was just the kind to impress the meaning of the word indelibly on their mind. Altogether we were very pleased with the lessons we were able to get from the snow, and when the next opportunity comes there is no doubt that fresh ideas will suggest themselves for still further instruction.

CHAPTER XII

The Quarry

A QUARRY of any description will prove a particularly profitable subject for an *al fresco* observation lesson. It is a pity that more use is not made of the lessons it affords by teachers who include Nature Study in their curriculum. Boys especially will welcome an opportunity of using their physical strength in a little amateur stone-breaking, and girls become quite enthusiastic geologists when once they have found some pretty fossils or sparkling minerals.

Rock specimens may not be as beautifully coloured as the flowers and fruits of the wayside, neither can the development of lifeless fossils be observed, as in the case of the fascinating tadpoles and grubs. But the great age and romantic history of the early forms of life, combined with the fact that, when once mounted, rock specimens will rarely deteriorate but last for ever, compensate for any lack of interest in the way of life, colouring, or beauty of form.

Another advantage possessed by the quarry lies in the simplicity of the outlines of the rock layers, with the result that sketches can easily be made by quite young students. Children frequently find a difficulty in selecting from the mass of detail the main points of a tree, flower, or animal and transferring them to paper, but even in a quarry showing complicated stratification it is usually a simple matter to make a pencil sketch of the more or less geometrical shapes assumed by the rocks in their layers.

Previous Preparation

The geology professor preparing his students for an examination places in their hands detailed information of the composition, structure, and stratification of the rocks and the names and nature of the fossils (when present) before visiting a quarry. This is, perhaps, the best, certainly the most economical, course

BETCHWORTH QUARRY, SHOWING ROUNDED OUTLINE OF CHALK HILL

to adopt with adult students whose time is valuable, and who will be anxious to learn as much as possible in the limited time at their disposal. The teacher of young children, on the other hand, will not be so much concerned about what they *learn* as about what they shall *see*. The learning will come fast enough when children have been trained to observe carefully,

sketch accurately, and then—*think*. If previously prepared, the young students will know what to look for, and the lesson loses much of its value as a training in observation and deduction.

We give suggestions for "A First Visit to a Chalk Quarry," including rather detailed "notes of lessons" for the benefit of younger teachers. A chalk quarry is chosen because chalk is a very common rock, and provides a variety of useful illustrations, but the teacher in limestone or sandstone districts should have no difficulty in adapting the method to his own particular quarry.

Notes of Open-Air Observation Lesson on "A First Visit to a Chalk Quarry"

To Children of Standards III, IV, or V

Each boy requires a Hammer, Satchel, Note-book, and Pencil

Things to be Found, Observed, or Sketched.	Questions to be Asked of the Scholars.	Deductions to be Drawn and Information given by the Teacher.
(1) *Fossil Shells.*	What does the specimen look like? (Shell.) Where would you look for such shells now? (Seaside.) Have you ever seen any shells just like them? Is it hard? Scratch it with a knife. Is it as hard as the chalk? As hard as granite?	Shells like this which have been turned into hard stone are called fossils. They have funny Latin names (give one or two), but you need not remember them.
(2) *Fossil Sea Urchins.*	What does this specimen look like? (Possibly not known.) Where have you seen similar ones? What were they covered with? Can you see any spines on the fossil sea urchin? Are there any signs of where they have been?	Chalk contains fossil sea urchins. Their spines have been rubbed off. If you search carefully you may find the loose spines scattered in the chalk.

Things to be Found, Observed, or Sketched.	Questions to be Asked of the Scholars.	Deductions to be Drawn and Information given by the Teacher.
	Should you say this has been turned into stone? What would you call it then? (A fossil.)	
(3) *Fish Scales.*	What do these things resemble? Are they like the scales of fish in the shop? In what way do they differ? (Browner and not so clear.) Scratch them and say whether you think they have been turned into stone.	Chalk often contains remains of fish, but these are rarer than the shells.
(4) *Fish Teeth.* Ordinary side, teeth and flat palatal teeth (Shark.)	What do these look like? Of what animal? (Boys will probably not recognize the palatal ones.) Do they look like real teeth or are they fossilized?	Chalk contains sharks' teeth of two kinds. Sometimes the actual part of an animal is preserved in rocks. These are called fossils, too.
(5) *Flints of all shapes.*	What are the rounded lumps made of? Break some open. Is the flint hard to break? Is it hard to scratch? What other substance was as hard to scratch? (Quartz in granite.)	Chalk contains a lot of flint. It is very hard—being an impure form of quartz. It was largely used by the early savage inhabitants to make various implements.
(6) *Fossil Sponges* either in the middle of flints or in the chalk.	What does this look like? (Probably—"Some kind of a plant.")	It is not a plant but a very low form of animal which grew in colonies like coral. It is a kind of sponge.
(7) *The Rock Layers.*	How do the rocks lie in this quarry? Would chalk be a rock like granite that had cooled down from a molten condition or one like	Chalk was laid down in the sea. The *Challenger* was sent out by Government to investigate sea bottom. Floor of ocean covered

Things to be Found, Observed, or Sketched.	Questions to be Asked of the Scholars.	Deductions to be Drawn and Information given by the Teacher.
	sand and clay laid down by water ? Would the presence of fossils bear that out ? Where would you find sea urchins, sponges, sharks, etc., in lakes—rivers, seashore—or in deep sea ? Where do you think chalk was laid down ?	with whitish ooze similar to chalk. Under microscope both shown to be made up of minute shells of very simple jelly animals.
(8 *Outline of Chalk Hill.*	What do you notice about the shape ? (Round.) Are other chalk hills like it ?	Chalk hills usually have rounded outlines.
(9) *Lime Kiln.*	What is placed in the kiln ? (Chalk and coal.) What is the lime like, hard or soft ? What is it used for ?	Chalk is largely used for making lime. A gas is given off when chalk is heated in a kiln, and lime is left behind.

After-work in the Classroom

A visit to a chalk quarry is of sufficient importance to warrant several lessons being devoted to revision.

One might well be spent going over the fossils. When in the quarry, all specimens worth keeping should have been carefully wrapped in paper before being packed in the satchel. There is no need to give scientific names, though, if the teacher should know them, it is worth while to give the boys one or two for the fun of the thing. "Micraster cor-anguinum" sounds clever, and boys delight to hear it roll off their tongues.

Where a microscope is available, the children should certainly be allowed to compare the foraminiferae found in the chalk with those brought up by the *Challenger*.

Intelligent boys are certain to enquire how the deep sea chalk came to occupy such a height as 600 or 700 feet. An explanation of how the contraction of the earth in cooling caused the earth's crust to crumple up would supply material

SEARCHING FOR FOSSILS
IN THE CHALK

for yet a further lesson. This may seem rather advanced work for boys of 10 and 11, but the subject crops up so frequently that some answer has to be given. It is quite possible to explain the general principle of the matter by forming

a ring of a dozen boys shoulder to shoulder and at a given signal allowing them to take a step to the centre. The round shape of the ring will at once be lost. Weak boys will be crushed out—into "mountain masses."

OLD CHARLTON QUARRY, SHOWING THE ROCKS UNDER LONDON

CHAPTER XIII

Pond Dipping

No branch of Nature Study fascinates a child more than Pond Life. Boys in particular revel in the joys of Pond Dipping, which, while affording much of the excitement of angling, does not entail a wait of half-an-hour for a bite. What delightful objects for observation find their way from the pond to the little jam jar aquarium! What marvellous transformations take place! What thrilling tragedies are enacted under the very eyes of the observers! No wonder the announcement of a Saturday pond-dipping expedition is sufficient inducement to save sweet-money for weeks beforehand.

It is a simple matter to announce a pond-dipping journey, but it is by no means an easy one to conduct a large party of children. It is still more difficult if it has to be made a "lesson" of the regulation hour and a half in school time.

A class of fifty or sixty can be put to sketch a tree, pick flowers, or follow a stream, but it will not do to have that number of excited children dragging a pond at the same time. Nevertheless, there is so much for children to learn from actual work at the pond, so much to tell them what *not* to do when they visit it themselves, that at least one pond lesson is desirable each season, apart from the necessity of stocking the school aquaria. From what has already been said, it will be obvious that a free and easy Saturday excursion will be preferable to a formal "school journey," and the smaller the number of children to each teacher, the better for all concerned. We will take, however, the most

difficult conditions and assume that a class of fifty is to be taken out for a definite lesson in school time. The teacher should have at least a P.T. or a steady big boy to keep an eye on the more lively children while he is engaged with the actual pond dipping.

Suitable Ponds

Very few, if any, ponds are available for "dipping" by a class in London itself. The Park ponds are mostly enclosed. The Hampstead and Highgate ponds have plenty of life, but

PRELIMINARY SURVEY OF POND

"dipping" by any number of persons would soon attract the restraining attention of keepers. The town teacher will almost certainly have to go out some distance for his pond. The country teacher is likely to have ponds near at hand.

Not every pond will yield good specimens. If ducks or fowl of any kind use it, they will in all probability do all the "dipping" there is to be done. The teacher will look out for water which has plenty of weed growing in it: where water weed is growing, animal life is likely to accompany it. A small stagnant pool covered with floating duck-weed will be more useful than a large lake with clear water. A disused canal,

or the backwater of a brook will prove a glorious hunting-ground, and with such favourable circumstances it may be possible to let the whole class " dip " to their heart's content.

Implements Required

At least one net will be wanted. If the pond area is limited and it is not convenient for a number of dippers to work together, the teacher alone should take a net and forbid all others. This is, perhaps, the best plan with a class. The

POND DIPPING IN RICHMOND PARK

children can go out with their little nets in ones and twos on Saturdays or in their holidays.

There is no need to buy a net. A conical muslin net can easily be made, and the hem round the top threaded with a flexible piece of drain cane, the two ends of which are firmly fastened with copper wire or stout string to a bamboo stick. It should be made very strong, as the net has to be dragged at times through dense weeds or along the mud which forms the bed of the pond. The children will take tins and jam bottles to hold the specimens captured. If the teacher wishes to do the thing in style, he can, of course, take a proper

fish can, for small fish and tadpoles, and a vasculum to hold pond-weed and such animals as snails and beetles which can be packed between it.

Preparatory Notes

It is well to hektograph a sheet of notes for each child. This would contain sketches of the chief animals to be found and directions for storing them in the tins or bottles. They must be warned most particularly to throw back into the

A BIG HAUL

water every bit of pond weed and every animal they cannot accommodate at home or at school. Nothing must be left to die or decay on the bank, and the teacher should set an example by scrupulously obeying the rule himself.

At the Ponds—Survey Work

Arrived at the pond, and still assuming a large class with a limited hunting ground, the teacher may divide his class into divisions of about ten or a dozen each. While one section stays with him to assist at the actual dipping, the others must be given work to do which will keep them seriously occupied.

Fortunately, there is much to be learnt from a pond without putting a net into it. A good occupation would be to make a careful map of the pond, putting in details concerning its depth, nature of banks, presence or absence of weeds, and the particular kind of weed found in different parts. This survey of the pond will provide most useful information for after lessons in the school. Children should be encouraged, not only to *find* pond animals, but to observe their habitat and discover, as far as possible, their method of life in the water. They will then be better able to reproduce in their own little aquaria the conditions most suited for rearing their captives.

WHAT HAVE WE FOUND ?

Another occupation would consist in lying on the ground and gazing intently into the pond for five minutes. Nothing may at first be seen, but it will be an exceptional pond which does not reveal some life as the eye becomes accustomed to gazing into the water. Not improbably the apparently lifeless twigs will prove to be caddis "worms"—amongst the most interesting and instructive of the pond's inhabitants.

At the right season, tadpoles of the frog, toad, and newt will be obtainable from the bank without a net, whilst water snails of several species will be found round the sides of the pond.

There is, therefore, plenty of work for the rest of the class to do while the teacher is occupied with his " Dipping," if he can trust the children by themselves or arrange for their supervision.

At the Pond—Dipping

This is not a chapter on pond life, but an attempt to show how a pond may be utilized in the School Journey. I do not, therefore, propose to describe in detail the various water plants and animals likely to be met with. Some of the commoner ones will be known to every teacher; the rest will readily be recognized by referring to a good book, such as Mr. Furneaux', if it is impossible to get personal assistance, or to compare them with specimens in museums.

The net will be dipped into the water as far out as possible, and worked slowly along for three or four yards, and then taken out for examination. The set of children " assisting " the teacher will gather round to share in the spoil.

If the net has been dragged along the bottom, it may contain a good deal of mud, and this may be tipped out on the bank. Otherwise, there may be bunches of pond weed. At first, these may appear to have little life, but examine them carefully, and the mud or weed will be found to be all alive. The silvery sticklebacks will soon show themselves, and they should be placed at once in the largest fish can, as they require well aerated water. It is of little use to place them in jam jars unless they are to be taken to less confined quarters within an hour's time.

The pond weed should be packed in the vasculum or tins, for a lot of it will be wanted for the aquarium, not only to aerate the water, but also to provide food for the vegetarians.

All the snails may be placed in the tins among the weed; they can do without water for some time. Newts, water boatmen, water beetles, water scorpions, and dragon fly

nymphs will also travel home between damp weed. Some of these are voracious carnivorae, and would kill most of the tadpoles or fish in a short time. The " catch " of the afternoon will be the big Dyticus beetle, and, if found, he should be placed in a tin or jar by himself, as he is at once the rarest specimen and the worst offender of all.

After the mud and weed have been turned over and examined carefully, all that is not wanted will be thrown back into the water, and the dipping operation repeated.

TEACHER DIVIDES THE SPOIL

With ordinary good fortune, a few dips will supply ten or a dozen boys with a small quantity of weed and one or two specimens each—quite enough to put in one jar and quite enough to make a start with. Ponds differ considerably. Some will yield water spiders in large numbers, others will be the home of the water scorpion, while only snails may be found in another part. The boys must not expect to get a large variety of specimens ; it will be far better to understand one or two first.

The first division of boys having been supplied, they may now be dismissed to take up the survey work, or catch more

specimens with their hands, while a fresh batch of boys take their place round the teacher.

What to do with the Specimens

There is no need for a boy to spend half-a-crown on an aquarium when a glass jam jar will do as well.

Into this he may place (without washing) the contents of his tin, and nearly fill up with water. The weed need not be planted; it will live and give off oxygen in the sunlight, and caddis, snails, and tadpoles will thrive on it. The carnivorous beasts must be supplied with flesh, either in the form of tadpoles, sticklebacks, little worms, or small pieces of raw meat. They will, of course, be kept in separate tanks from animals which are not to be eaten.

Children should be discouraged from keeping *fish* in these little bottles. A tank well supplied with weed is wanted, or else the water must be changed very frequently. It is best to have a large aquarium with weeds "planted" in sand or gravel for fish. If placed in the sunlight, the weed will aerate the water, which need not then be changed for a month or two.

CHAPTER XIV

The Points of the Compass and Hidden Treasure

PROBABLY one of the driest Geography lessons that falls to the teacher's lot is that of making little children in Standards I and II learn about the points of the compass. We had laboured for one whole lesson, trying to teach the youngsters that the sun rises in the east and sets in the west. We had turned them to the south at midday, and had told them to put out right and left arms in turn; but they were not at all impressed, and at the end, both teacher and children were heartily sick of north, south, east, and west.

The afternoon being fine, we decided to try open-air treatment, and from the summit of Parliament Hill we were able to fix the direction of several known places by means of the sun. This was better, but still there was not the enthusiasm one likes, if possible, to secure.

Then suddenly came the idea of "Searching for buried treasure."

"Come round me, boys," said the teacher. "I want you to fancy you are all grown up to be big men." Instantly their eyes sparkled. "See, I will wave my fairy stick over you—so—and now we are all big, tall, strong men. But we are very poor, and we can't get any work. Very soon our money will be gone, and we shall starve. What can we do?"

"Go to the workhouse," suggested one boy.

"We've got a better plan than that, but it's a very great secret. Promise me faithfully you won't tell any other men. I have been told that across the sea there (pointing to one of

the ponds), in a far-off country, there is some buried treasure —gold, silver, diamonds, and a king's crown worth thousands of pounds. We've just got enough money left to pay our fare. Shall we take a ship and sail across the ocean ? "

Fresh from the Infant School with its fairy tales, these children of six and seven entered into the spirit of the thing immediately. Sighting a toy sailing vessel, one boy at once claimed it as " our ship," and as we walked round the pond to the other side, another lad volunteered the information that he felt dreadfully sea-sick. If only there had been a real boat to take them across !

Arrived in the foreign country, they were impatient to know where the treasure was buried. " I have the directions on this piece of paper," continued the teacher. " The man who buried the valuables was afraid to go back for them at once, and so he split them into four portions, and buried them in different places. This is what he says : ' Near the landing place is a big weeping willow tree.' "

" Here it is," several boys cried, and a move was made for the willow.

" ' Measure twenty yards due south from this tree.' "

The boys look round eagerly enough now for the sun. " Bother the clouds, we can't tell where the south is."

Disappointment was keen and real. The boys had arrived at what Prof. Adams calls the " gaping point," and this is *the* time of all to introduce the mariner's compass.

A large one was placed on the ground and the children were invited to watch it carefully. After a short time, they began to notice that after being moved the needle always came back to the same position, and a little later they were quite satisfied that it would not point permanently in any other direction. They were then told that the N. on one end meant North, and that a piece of steel of this kind balanced on a pin would always point to the North, and so show us where the North was.

"Which way, then, must we go to find our treasure?" In spite of the lesson in school, few of the boys had grasped the fact that the south was opposite to the north, and they had to be told again, only now they had a reason for remembering.

"One end of our needle is pointing to the north—and the other?"

"To the south."

"And what else?"

"Oh, the treasure!"

Then came the question of the yard. We might have taken a yard measure and done the thing accurately, but pacing out the distance provided more fun, and absolute accuracy at this stage was immaterial. The teacher showed them that three of his big "feet" made about a yard, and the boys found that by taking a *long* stride they could pace a yard at each step.

The compass was placed just in front of the willow tree, and each boy in turn stepped off from the tree, over the compass, and paced out twenty yards in what he thought was the direction of the needle. The class was nicely scattered at the end of this performance, and more excitement followed when the teacher knelt down, and looking along the needle decided who had walked due south. He then paced out the twenty yards himself, and very proud was the boy who happened to have alighted on the right spot.

"Is the treasure under my feet?" he asked. (This would have finished the lesson too soon.)

"No, I told you it was divided into four parts, but this point is an important one, and so I will place my stick in the ground on it. Let me see what the secret writing says. 'Ten yards further south I have hidden the silver; a chest of gold is fifteen yards due east; the diamonds lie sixteen yards to the west; and the king's beautiful crown you will find five yards to the north.'"

The class was divided into four parts and the boys were sent off in turn according to these directions.

Again, being little fellows with lively imaginations, they scratched industriously at the grass, and pretended to find the treasure.

Afterwards they were gathered together, pencils and pocket-books were taken out, and sitting down facing the south, with the compass in front of them, they drew a line

STEPPING OUT SIXTEEN YARDS DUE WEST BY MEANS OF THE COMPASS

down the middle of a page to represent the line of the needle. South was written at the top, North at the bottom. A line at right angles was added with East on the left hand and West on the right.

(It may be objected that this arrangement, being opposite to that which the children will later find adopted on a map, is a bad beginning. But at present we are anxious to bring in the sun, and he will, of course, rise on the left hand and set on the right. It is only necessary to turn the book round to place it in the position commonly adopted on maps.)

A small circle is placed at the top of the page to show that

he is in the south at his highest point—that is, midday—whilst semicircles are inserted on the east and west line to show sunrise and sunset. A dotted line is then added to indicate the path of the sun, the children saying after the teacher as they do so, " The sun rises in the east, at twelve o'clock he is in the south—and then he goes down to set in the west."

We were particularly pleased with the results of this lesson. First and foremost, the children had had a good time ; they had learnt about the sun at rising, midday, and setting ; they had seen the need of some other means of telling direction when clouds obscured the sun ; and they had *used* the mariner's compass. Further, they had seen that three feet make a yard ; that a long stride of theirs was about a yard ; they had learnt to spell north, south, east, and west, if they were not certain of those four words before.

Later, during a Saturday excursion to Epping Forest, we pushed one or two halfpennies into the cracks of the soil, and at twelve o'clock gave the distances from a stick placed in the ground. As the sun was shining brightly, throwing a distinct shadow to the north, the boys had a good opportunity of finding the direction by its means. Needless to say, there was no lack of enthusiasm on this occasion.

CHAPTER XV

Colonising Hampstead Heath

We have already suggested in the "Hidden Treasure" lesson for learning the points of the compass, that the School Journey may with advantage be used to stimulate the imagination, side by side with the imparting of actual information. Seeking for Hidden Treasure is suitable for little boys in Standards I and II. For Standards III and IV, we have found that "Colonising" experiments supply problems sufficiently difficult to prevent the lesson degenerating into a mere game and, at the same time, to prepare the way for classroom lessons on the Colonies later on.

The method of treatment will, of course, vary according to the nature of the "country" at the teacher's disposal. At Kentish Town Road, we use our old friend the Valley of the Fleet Brook, letting the highest of the Hampstead Ponds represent the ocean across which we have sailed from the Old Country. Walking round the Pond (instead of sailing), the boys are first asked to suggest a suitable landing place, bearing in mind the fact that the sea is distinctly rough. As the Pond has no natural harbours, the class is driven to the upper end where the River enters, and they are thus led to see one advantage of making a landing in a navigable river.

They may also be led to see that a circle drawn round a seaport embraces less land than a similar circle drawn round a river port, and that the farther up a river they can take their ship, the larger area of land is brought within effective working distance of the new port.

Having landed, the children are asked to remember that they are in a new country where no civilized person has ever been

COLONISTS ROUND THE CAMP FIRE

before. Bridges, houses, and roads do not exist—they must ignore them absolutely.

What will be the first thing to do ?

To make a camp and then explore the country. On one occasion, the gardeners had lit a fire of dead branches and rubbish. This was promptly appropriated as a camp fire, round which the colonists discussed (for ten minutes) their plans.

Exploring the Country

What do we want to know about the new country ?

" What food we can get," suggests a real boy. Yes, very important, as our stores won't last for ever. Boys will at first suggest apples, potatoes, and other cultivated vegetables as foods to be sought. It will take some time to make them grasp the fact that they have uncultivated Nature alone to draw on. Wild animals will be suggested, and it will be interesting to note what animals they think are good for food. The ignorance displayed and now *felt*, may be used to point out the advantage of reading books of adventure. The correct answers come from boys who have read " The Swiss Family Robinson " and such books.

Yes, we must look for food, but we not only want to live, we want to make our fortunes if we can.

Gold, diamonds, silver, will be suggested readily enough, but the lads must be led to see that not only the rare metals are precious, but that coal and iron may be equally valuable.

And this river—can it be of any use to us ? We may perhaps be able to use it for carrying our goods—if it be navigable.

The boys are then sent out, some up the river, others up the hillside (mountains, we call them), and told to return at the close of the day (*i.e.*, in five or ten minutes) with their reports. These reports will be vastly amusing, and will reveal quite a new side of individual boys' knowledge, and particularly their power of imagination and sense of humour.

COLONISTS EXPLORING THE RIVER

The river is generally done very well. It is said to be navigable for ten, twenty, or thirty miles when waterfalls will bar our passage. Of the rest, some will still report that they have seen a church or bicycle. Others will let imagination run riot in monkeys, lions, and tigers. Some will find cocoanuts, bananas, and dates. Few probably will find gold or coal. One boy found a little bit of coke and had the sense to report—coal. We promptly journey to that spot, and start "Coal Town." Farther along the hillside half of the boys are told off to work in imaginary gold mines, into which they enter with zest and a certain amount of understanding. After a short time a halt is called.

"We have now been at work three months. We have found gold and coal, but our stores are running short. Ah, there is a ship coming in." We leave our work and journey down to the mouth of the river, the gold miners taking their gold with them. Yes, the ship has food—for sale. The gold miners exchange some of their gold for food and clothes.

"But won't you give us food for coal?"

"Yes, with pleasure—where is it?"

"Up in the hills—twenty miles away."

"Very well, bring it down here."

This is, of course, impossible, and the lads soon see that a railway will be wanted if the country is to be developed. Even the gold miners see that it will be no joke to carry their stores from the river up to their town every time.

Railway Planning

Now comes railway planning, a most instructive exercise. We take the boys back to Coal Town and Gold Town. Which way shall the railway run?

Almost invariably the boys suggest two lines—running straight down the hill from the two towns to the port. This, of course, will not do and the boys must be led to see the necessity of finding an easy gradient.

"Who has a toy engine? Suppose you put your toy engine on a line running straight down—how would it go down?"

"It would dash into the river."

"Could your toy engine work its way up this hill?" Obviously not. "How can it run?"

"On a level, or up a little—or down."

Then our railway cannot go in a straight line, but must go down as gently as it can.

The next step is to get them to see that it will be an advantage to make one railway serve both towns, not only to save expense, but also to put them in communication with one another.

One or two "engineers" are then sent off to plan out the line, the boy who has a toy engine watching and calling out if he thinks they are going down too steep a gradient. Afterwards the whole class marches down the route in single file, so that they may see clearly how the line must bend round and avoid little hills or tunnel through them. (When dealing with a larger portion of the Heath, we are able to let the boys see that the riverside affords the easiest gradient in getting to the top.)

Now follows the very important exercise of making a map, putting in the river, mountains on each side, the two mining towns, and the port, and, last, but not least, the railway. The boys are allowed to christen the river and mountains after their own leaders or some place at home, just as real colonists do.

Other Variations

This brief outline of a lesson does not, of course, embrace the complete art of "colonising." Every teacher varies it—and every time the lesson is given some fresh idea for making it useful or additionally interesting is discovered.

Mr. J. W. Gofton, one of our teachers, followed this idea up in a very clever manner by imagining that the class was a second batch of colonists, attracted by the glowing accounts sent home by the miners of Gold Town and Coal Town.

Each boy was allowed to choose his own favourite trade and great was the chagrin of the clerks, policemen, and motor-drivers to find that there was nothing for them to do, whereas the smiths, carpenters, and bakers were soon hard at work.

It may be thought that work of this description savours too much of "organized game" to be considered a geography lesson. In our case, H. M. Inspectors who have seen us at work certainly have not objected. Indeed, one suggested that the boys might be allowed to engage in mimic battle with savage tribes, a thing we should hardly have felt justified in doing, except as an organized game. We should say that teachers need not hesitate to try experiments off the strict "lesson" line, provided they are satisfied that the work is truly educational.

Scheme of School Journeys

IN SCHOOL TIME

(NOTE.—*This is submitted as a specimen scheme only, adapted to the neighbourhood of Hampstead Heath. It varies from year to year, the special qualifications of the teachers being taken into account.*)

STANDARD I

Tree Study of	Oak.
	Lombardy Poplar.
	Chestnut.
	Holly.
Earth Lore.	Lessons on Lakes, Islands, Capes, Bays, Hills, and Streams.
	Cloud observation.
	Finding direction by means of the compass.
	"Hidden Treasure" Games.
Visit to the Zoo.	General walk round to recognize some of the more striking animals.

STANDARD II

Tree Study of	Elm.
	Plane.
	Willow.
	Scotch Pine.
	Revision of Standard I Trees.
Earth Lore.	Hills and their Outlines.
	Rivers, Tributaries, Bed, Banks, Source, and Mouth.
	Valleys and Watersheds.
	Use of the Compass and Map in finding one's way.
	Cloud observation.
	Snow lesson (if possible).

Visit to the Zoo.	Animal curiosities, *e.g.*, long noses, long tails, long necks, long legs. Striking examples of offensive and defensive weapons.

STANDARD III

Tree Study.	Sycamore. Ash. Lime. Birch. Hawthorn. Revision of Standards I and II Trees.
Earth Lore.	Work of a river in excavating valleys and making scenery. Measurement of width and depth of Fleet Brook at different points. Rocks of the Heath and Vegetation supported. Railway planning along easy gradients. "Exploration and Colonisation." Clouds and Snow (if possible).
Visit to the Zoo.	Elementary ideas of Classification in Mammals, Birds, Reptiles, Amphibians, Fish, etc. Animal clothing in different climates.

STANDARD IV

Tree Study.	Beech. Alder. Black Poplar. Hornbeam.
. . .	Class to make a rough Tree map of Parliament Fields.
Earth Lore.	Estimation of Speed of Stream. Rough map of River Fleet. Rocks and Soils of the Heath. "Colonisation." Clouds and Snow (if possible).
Animal Study.	Sheep. Caterpillars. Pond Life.

Visit to the Zoo. Special Study of Birds—their methods of locomotion—defence, and obtaining food.

Visit to Natural History Museum. A peep into all the rooms to show what is there.
Special attention to animals in Entrance Hall.

STANDARD V

Tree Study.
- White Poplar.
- Wych Elm.
- Hazel.
- Ailanthus.
- Walnut.
- Elder.
- Sweet Chestnut.

The work will be confined almost entirely to sketching and painting by this class.

Earth Lore. Scenery Study.
Introduction to Contour lines.

Visit to the Zoo. Sketches of typical animals.

Visit to the Tate Gallery.

(NOTE.—The Teacher of this class is a keen artist and the nature work is here subordinated to Art.)

STANDARDS VI AND VII

Tree Study.
Rowan.
White Beam.
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More extended study of Trees in their seasons.
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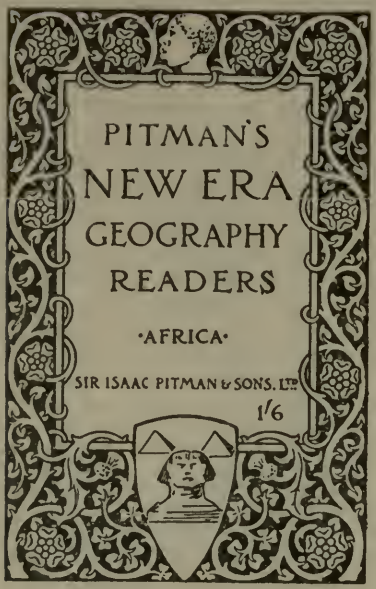

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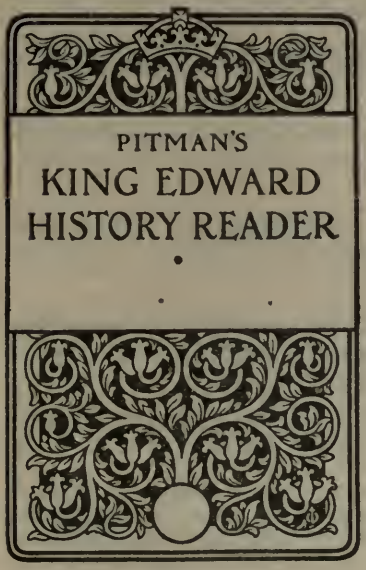

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